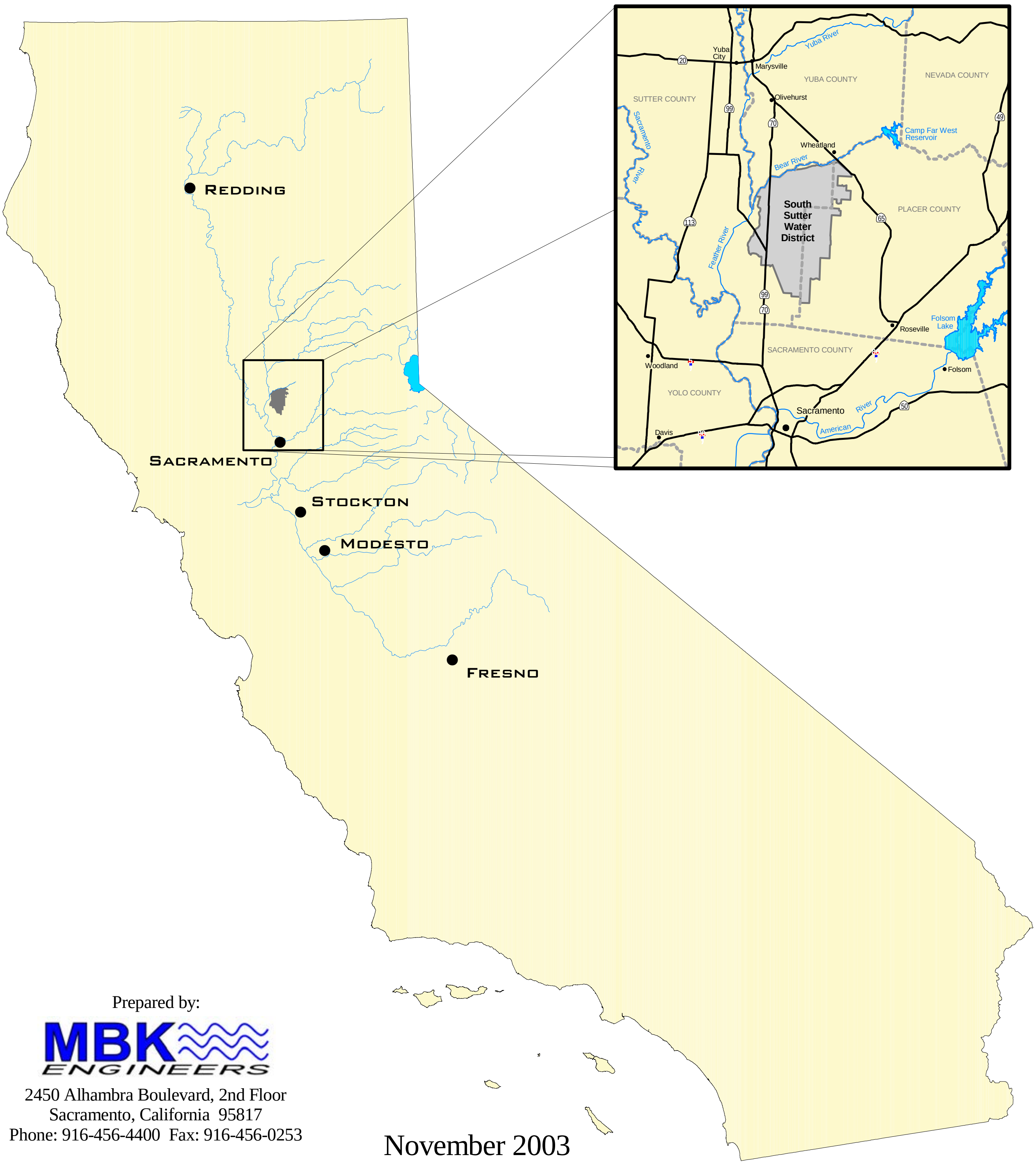
South Sutter Water District

Water Management Plan



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November 2003

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WATER MANAGEMENT PLAN

Pursuant to Agricultural Water Management Council (AWMC) AB3616

Prepared by

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1. INTRODUCTION

South Sutter Water District (SSWD) has prepared this Water Management Plan (WMP) to meet its obligations in the memorandum of understanding regarding efficient water management practices by agricultural water suppliers in California. We believe this WMP will demonstrate the efficient water management practices currently undertaken by SSWD as a matter of good business and stewardship.

The surface water supply for which this WMP covers was a direct result of declining groundwater levels. The surface water supply developed by SSWD has been used for in-lieu recharge effectively. Groundwater levels have raised and stabilized as a result of SSWD's actions.

The conjunctive use of both surface and groundwater supplies has been managed effectively through the organization of the SSWD. The effective management has not come as a result of a required WMP. This WMP has made SSWD recognize its efforts and hope that the sharing of this information results in others realizing that efficient water management does not require regulatory action.

2. DESCRIPTION OF SOUTH SUTTER WATER DISTRICT

A. History and Size

South Sutter Water District (SSWD) was formed in May 1954 to develop, store, and distribute surface water supplies for agricultural irrigation uses primarily from the Bear River via an enlarged Camp Far West Reservoir. SSWD was also formulated to utilize and distribute local surface waters originating in Yankee and Ping Sloughs, Coon Creek, Bunkham Slough, Markham and Auburn Ravines, King Slough, and Pleasant Grove Creek, located mostly in the southeastern portion of Sutter County and within a southwestern portion of Placer County, California.

Upon formation of SSWD in 1954 and prior to the completion of the enlarged Camp Far West Reservoir in 1964, SSWD's boundaries encompassed a total gross area of 63,972 acres, of which 8,915 acres were excluded, for a net area of 55,057 acres. The development of the surface waters, primarily enlarging Camp Far West Reservoir and developing a distribution system, was an effort of SSWD landowners to augment and develop alternatives to a declining groundwater table that was being tapped by private agricultural wells within the service area. Reportedly, the groundwater basin was being overdrawn by 1 to 3 feet per year or by as much as 10,000 to 11,000 acre-feet per year, and the formation of SSWD and subsequent enlargement of Camp Far West Reservoir would furnish sufficient water to replace the overdraft. The exclusion of 8,915 acres in 1954 was a result of some landowners requesting to remain exclusively on their private agricultural wells and limited surface water sources from the local sloughs, ravines, and creeks.

The 1950 census revealed a population of approximately 1,800 people within the boundaries of SSWD. Based on 1950 crop data, it was estimated that approximately 18,593 acres received approximately 99,600 acre-feet of water, of which 80,600 acre-feet was obtained from the underlying groundwater supply and approximately 19,000 acre-feet was from surface sources, the majority being from upstream irrigation tail water and surplus power flows.

In 1956, prior to the expansion of the Camp Far West Reservoir, approximately 20,955 acres, or 38 percent of the net SSWD area, was being irrigated with approximately 109,000 acre-feet of water, of which approximately 90,000 acre-feet was pumped from the groundwater basin and 19,000 acre-feet from surface sources. At this time, the 20,955 acres under irrigation consisted of 10,925 acres (or 52 percent) in rice production, 3,080 acres (or 15 percent) in orchards, 4,160 acres (or 20 percent) in irrigated pasture, and the remaining 2,790 acres (or 13 percent) in field or row crops. Table 1 identifies the historical land use and crops irrigated within lands of SSWD.

In 1958, it was estimated that the underlying groundwater basin could safely recharge at an average annual rate of 80,000 acre-feet and that the average annual net production from the improved Camp Far West Reservoir system (which now exists today and accounts for approximately 6,900 acre-feet of conveyance and distribution losses) could safely yield 59,000 acre-feet. Thus, it was anticipated that an average annual conjunctive yield or availability of 139,000 acre-feet was available to ultimately serve approximately 31,800 net acres (4.37 acre-feet/acre). It was also believed in 1958 that as much as 51,214 acres of SSWD’s 55,057 acres was suitable for seasonal irrigation, but only 47,450 acres could be ultimately irrigated due to distribution and soil constraints.

In 1964, upon completion of the 104,400 acre-foot Camp Far West Reservoir, conveyance canals, and some low pressure pipelines, SSWD began surface water deliveries and sold 63,630 acre-feet through its newly developed surface water system. With the exception of severe drought years, surface water sales over time have varied from 70,000 acre-feet to over 130,000 acre-feet. Table 2 is a summary of surface water sales, including surface water provided by Nevada Irrigation District (NID) under its pre-1914 water rights. As of 1975, SSWD was providing surface water for approximately 20,000 acres, of which 11,000 acres was planted in rice, with the balance in pasture, orchards, and field crops.

Today the annual available supply from the Camp Far West Reservoir is totally allocated each year, and a full reservoir represents only a portion (approximately 2 acre-feet per acre) of the users’ demands. SSWD’s boundaries still encompass a total gross area of 63,972 acres, of which 6,960 acres are excluded, for a net District area of 57,012 acres (40,107 acres are in Sutter County and 16,905 acres are in Placer County). In recent years, only 35,645 of the 57,012 acres within SSWD boundaries have been irrigated in any given year with a combination of surface and groundwater; and as many as 13,000 acres are reportedly irrigated with only groundwater.

The annual quantity of groundwater continues to provide a dependable source and displacement for surface water, particularly during drier years. Groundwater extraction is dependent upon available annual surface water supplies. The groundwater basin underlying SSWD lands declines during drought years but stabilizes during normal and wet years when ample surface water is available. Only the extreme southern portion of SSWD is experiencing a decline in the groundwater levels due to pumping outside of SSWD. Table 1 shows that the current lands under irrigation have increased to over 35,500 acres with approximately 29,000 acres (or 82 percent) in rice production, 3,800 acres (or 11 percent) in orchards, 2,200 acres (or 6 percent) in irrigated pasture, and 500 acres (or 1 percent) in miscellaneous row and field crops.

B. Location and Facilities

SSWD is located along the western toe of the Sierra foothills just south of the lower reaches of the Bear River between the Camp Far West Reservoir and the Bear River's confluence with the Feather River in southern Sutter and western Placer Counties. The SSWD boundaries and distribution system, starting at its northeast corner near the town of Sheridan and State Highway 65, extends to the west beyond State Highway 70 and to the southwest to the Pleasant Grove Creek Canal and Curry Creek drainage area. The SSWD service area drops approximately 80 feet in elevation from its highest elevation of 100 feet MSL near Sheridan to a low elevation of approximately 20 feet MSL near its most westerly boundary, 2 miles west of where State Highways 70 and 99 depart from each other. Figure 1 shows the location. Figure 2 shows the SSWD boundaries, areas excluded from services, and the major surface water distribution systems.

The majority of the surface water supply is provided by the Bear River where the water is stored behind Camp Far West Dam creating the Camp Far West Reservoir. The reservoir has a total gross capacity of 104,400 acre-feet, of which approximately 2,200 acre-feet is dead storage. In most years, the reservoir fills by February 28 with precipitation runoff and little contribution from snowpack runoff.

Water released from the reservoir is rediverted from the Bear River at a point approximately 13 miles downstream from Camp Far West Dam into the SSWD Conveyance Canal which runs predominately north to south along the higher eastern border of SSWD. Through turnouts and head gates, water is directed from this conveyance canal into improved canals, one pipeline, and natural channels running from east to west, and distributed to water users. During the irrigation season, the natural channels, some of which have been improved to convey agricultural water, contain negligible amounts of natural stream flow and convey agricultural irrigation water provided from the main conveyance canal. The natural channels periodically carry runoff from upstream agricultural drainage, municipal runoff, and sewage effluent. (See Figure 2 which shows the major water conveyance and distribution canals. Table 2 shows a summary of the irrigation conveyance and distribution waterways and canals within the District.) On a year-to-year basis, SSWD purchases surplus water from the Nevada Irrigation District (NID) via the Auburn Ravine.

Flow through SSWD's main conveyance system from the Bear River and the Camp Far West Reservoir is presently limited to approximately 435 cfs which is the capacity of the upstream conveyance canal as it passes under State Highway 65 and the Union Pacific Railroad near Sheridan. Direct diversion and storage quantities and associated seasons are limited by the operating conditions placed on SSWD's appropriative water rights, in-stream fishery flows, and senior water rights held by the Camp Far West Irrigation District.

The District does not provide groundwater supply; however, most landowners pump groundwater at their own expense.

C. Topography and Soils

SSWD is located along the western toe of the Sierra foothills where the foothills transform from gentle rolling hills into the eastern side flat lands of the Sacramento Valley, south of the Bear River. The service area drops approximately 80 feet in elevation from east to west with its highest elevation of 100 feet MSL near Sheridan to a low elevation of approximately 20 feet MSL near its most westerly boundary, 2 miles east of the Feather River. Figure 3 is a reproduction from excerpts of the Placer and Sutter County soil classification maps developed by the Natural Resource Conservation Service (NRCS).

The general soils found in the SSWD are divided into three categories based on the terrain: (a) soils of the nearly level floodplains; (b) soils of the nearly level basins; and (c) soils of the nearly or level to rolling terraces.

The soils of the nearly level floodplains (a) are adjacent to the Bear River and the western boundary of the SSWD, extending eastward along Auburn Ravine, Coon Creek and Yankee Slough. These are moderately well drained and moderately coarse to coarse textured soils developed in stratified medium to coarse textured alluvium. These soils are used mostly for irrigated orchards, pasture, and row crops.

The soils of the nearly level basins (b) consist of somewhat poor to poorly drained soils developed in moderately fine to fine textured alluvium. These soils occur at an elevation of 30 to 60 feet MSL in a north/south line on either side of Highway 70 and cover a large portion of the SSWD lands. These soils have high shrink-swell behavior and are primarily used for rice, cereal grains, and some field crops.

The soils associated with the nearly level to rolling terraces (c) occur in the eastern area, mostly at elevations above 50 feet MSL. Most of these soils are well drained, with a claypan or hardpan at 40 to 60 inches, and a sandy loam or loam surface layer. These soils have a variety of land uses such as winter grain, annual range, irrigated crops, rice and pasture.

According to the NRCS designation, the soil associations for each County within SSWD are shown in Table 4. A copy of the pertinent portions of the NRCS report referencing the soils identified on Figure 3 and Table 4 is attached as Appendix 1. Appendix 1 provides a general description of each soil and its general effects on agricultural practices.

D. Climate

The climate of the basin is typical of the Sacramento Valley with a warm to hot dry season from May through October and a cool wet season usually from November through April. Historic precipitation data was obtained through the National Climatic Data Center (NCDC) from the Nicholas 2 Station located in the northwestern portion of the service area. The monthly average precipitation data for the 36-year period of record, 1962 through 1998, is as follows:

AVERAGE MONTHLY PRECIPITATION FOR 1962-1998

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Avg. Precip. (inches)	4.12	2.87	3.01	1.41	0.47	0.26	0.06	0.07	0.37	1.11	3.00	3.15	19.83

The following historical temperature data (1941 - 1998) was obtained through the National Oceanic and Atmospheric Administration (NOAA) for the nearest representative temperature recording gage located at Sacramento International Airport.

TEMPERATURE DATA FOR 1941-1998

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Avg. Temp. (°F)	44.4	46.8	54.4	61.7	66.0	71.7	75.9	72.8	68.7	61.4	53.2	45.0	60.2
Max. Temp. (°F)	--	72	71	89	96	102	107	101	97	87	77	69	107
Min. Temp. (°F)	--	21	33	37	41	48	50	46	48	36	31	27	21

The bulk of the precipitation, about 88 percent, falls during the six-month winter/spring season of November through April. Only about 12 percent falls during the summer/fall months of May through October. Large variations in the quantity of annual precipitation and the normally small quantity of precipitation in the summer/fall months make irrigation mandatory. The precipitation that falls during the summer/fall months is available to help meet the crop water demands. Variation in this precipitation directly affects the quantity of water required from other sources to meet crop demands.

Ambient climate conditions have a direct effect on crop evapotranspiration (ET) rates. According to the California Irrigation Management Information System (CIMIS), the main factors that influence ET include incoming radiation (energy from the sun), outgoing radiation (energy leaving the earth), the amount of moisture in the air, air temperature, and wind speed. The ET value changes daily based on these factors and affects the quantity of irrigation water required. Average ET values are useful for planning crop water needs, but the actual ET can vary depending on climatic conditions. Additional water also is required for additional evaporation from canals and from other irrigation systems such as sprinklers.

Another factor affecting ET values is the location of the field. Differences occur along the upwind edge of irrigated fields bordered by dry non-irrigated fields. According to Department of Water Resources Bulletin 113-4, evaporation demand can be 40 percent higher along the edge of the irrigated field due to advection of relatively warm, dry air from the non-irrigated areas. Also, additional seepage occurs from irrigated fields next to non-irrigated fields. Thus the reduction in water use is not proportional to the reduction in productive cropland.

It is difficult to assess the numerous factors that affect the quantity of water required to meet crop water needs. These factors may result in as high as a 1 acre-foot per acre fluctuation in applied water demands from year to year. This fluctuation could cause a change in total water diversions from one year to the next with no change in crop pattern.

There are no microclimates within the basin.

E. Operating Rules and Regulations

Early each year, prior to March 1, when a reasonable water availability forecast can be made on the anticipated yield from the Camp Far West Reservoir, SSWD allocates the total amounts of water that will be available per acre in SSWD’s availability area. Depending upon the anticipated reservoir yield, the allocations may range from ½ acre-foot per acre during a drought year to as much as 2½ acre-feet per acre during a wet year when precipitation has been well above average. Perennial crops such as orchards and pasture receive a higher priority of allocation over seasonal crops with rice growers receiving the lowest priority.

Prior to February 15 of each year, water users submit applications to SSWD indicating the type and acreage of crops they intend to irrigate during the full irrigation season under their application; and by March 1 of each year, based upon the current applications on hand and the amount of water estimated to be available from the reservoir, SSWD confirms or adjusts the allocation to each owner and establishes the allocation in acre-feet per acre for the upcoming season. At that time, invoices are provided to each of the landowners on a measured $/acre-foot basis, a standby charge, and a possible surcharge to help defray the cost of supplemental water should it become available from NID. If additional water becomes available through NID, it is normally distributed on a pro-rata acreage basis to all crop users.

Appendix 2 is SSWD’s current set of Rules and Regulations for the Distribution and Use of Water, as revised and adopted August 31, 1993. Appendix 2 also includes a sample notice of water allocation and applicable rates, as well as examples of invoices to landowners within the availability area.

The availability area includes all areas within SSWD Boundaries where surface water can be reasonably delivered, with the exception of the excluded areas identified in Figure 2. If a landowner is in an excluded area and would like to obtain water, that owner must first be annexed into the availability area. Presently, approximately 13,000 acres within SSWD (outside of the excluded areas) are irrigated with only groundwater as these lands cannot receive surface water deliveries due to topography constraints and lack of distribution facilities.

F. Water Delivery Measurements and Calculations

SSWD records the daily water levels and controlled releases at the Camp Far West Reservoir as well as all of the water diverted downstream into the headworks of SSWD and Camp Far West Canals. SSWD also measures all of the water released downstream for fishery uses. In addition to measuring the major supply of water entering SSWD’s distribution system via the SSWD Canal, SSWD and NID collectively measure water provided by NID at Auburn Ravine and Coon Creek. SSWD also measures water released or discharged into the major distribution channels from the SSWD Canal inclusive of Yankee Slough, Coon Creek, Bunkham Slough, Markham Ravine, Auburn Ravine, King Slough, Pleasant Grove Creek, and the East Side Canal.

SSWD continuously meters or utilizes daily pipe flow and water level measurements at each of its customer's respective surface water delivery points to separately measure the water volumes delivered to each customer. These flow measurements are obtained using propeller flow meters or a water level measurement and theoretical rating on a weir structure calibrated at installation. The accuracy of these measurements is estimated to be within ±10 percent of the actual flow.

Groundwater quantities pumped are not measured by SSWD as they are all privately owned pumps and wells. However, the volume of groundwater pumped may be periodically estimated from private pump tests and power records.

G. Water Rate Schedules and Billings

Surface water users within SSWD are allocated water on an acre-foot per acre basis and are billed accordingly by the amount of water delivered in acre-feet. The price of water delivered depends upon if the water is: (1) delivered by gravity, (2) delivered through the Bear River Drive pipeline system, or (3) pumped by the owner from one of the drains, sloughs, or canals. Appendix 2 includes a sample notice of water allocation and applicable rates distributed to customers in the SSWD availability area.

H. Water Shortage Allocation Policies

Each year (near the middle of February) when a reasonable surface water availability forecast can be made on the anticipated yield from the Camp Far West Reservoir, SSWD allocates the total amounts of water that will be available per acre in the availability area. By March 1 of each year, based upon the current allocations on hand and the amount of water estimated to be available from the reservoir, SSWD confirms or adjusts the allocation to each owner and establishes the allocation in acre-feet per acre for the upcoming season. Perennial crops such as orchards and pasture receive a higher priority of allocation over seasonal crops with rice growers receiving the lowest priority.

3. INVENTORY OF WATER RESOURCES

A. Surface Water Supply

The major supply of surface water comes from the Bear River, where SSWD has licensed appropriative surface water rights for its Camp Far West Reservoir. The reservoir is located on the Bear River approximately 7 miles northeast of Sheridan and has a total gross capacity of 104,400 acre-feet, of which approximately 2,200 acre-feet is dead storage. In most years the reservoir is full by March 1 from precipitation runoff with little or no contribution from snowpack runoff. Recognizing Camp Far West Irrigation District's senior water rights of 13,000 acre-feet on the Bear River, SSWD has diverted a wide range of seasonal surface irrigation water from the Bear River, averaging close to 100,000 acre-feet per year, with no diversions during the drought year of 1977 and over 120,000 acre-feet during above normal and wet years.

In addition to surface water rights to the Bear River, SSWD diverts local surface water from numerous small streams within its boundaries, including but not limited to Yankee Slough, Coon Creek, Markham and Auburn Ravines, and the East Side Canal. These smaller streams redistribute and convey Bear River water routed through the SSWD distribution system from the

Camp Far West Reservoir in addition to the natural stream flows. The following summarizes SSWD's surface water rights:

Summary of Surface Water Rights

SSWD holds five post-1914 appropriative water rights. Two of the five licenses are for the direct diversion and storage of water from the Bear River at Camp Far West Reservoir. Each of these storage and direct diversion rights recognize Camp Far West Irrigation District's senior priority right for 13,000 acre-feet from the Bear River. The remaining three are for the natural flows available from Coon Creek, Yankee Slough, East Side Canal, Markham Ravine and Auburn Ravine.

License 11120 (Application 10221)

Priority:		June 13, 1941
Source:		Bear River
Purpose of Use:		Irrigation, Domestic and Incidental Power
Amount:	(A)	250 cfs
	(B)	40,000 AF
Season:	(A)	March 1 to June 30 and September 1 to October 31
	(B)	October 1 to June 30

License 11118 (Application 14804)

Priority:		May 12, 1952
Source:		Bear River
Purpose of Use:		Irrigation, Domestic and Incidental Power
Amount:	(A)	330 cfs
	(B)	58,370 AF
Season:	(A)	May 1 to September 1
	(B)	October 1 to June 30

License 4653 (Application 14430)

Priority:		August 16, 1951
Source:		Coon Creek
Purpose of Use:		Irrigation
Amount:		2 cfs
Season:		About April 1 to about November 1

License 11121 (Application 22102)

Priority:		April 12, 1965
Source:	(1)	East Side Canal
	(2)	Coon Creek
	(3)	Markham Ravine
	(4)	Auburn Ravine
Purpose of Use:		Irrigation
Amount:		40.3 cfs
Season:		April 1 to June 15 and September 1 to October 31

License 12587 (Application 23838)

Priority:	August 11, 1971
Source:	Yankee Slough
Purpose of Use:	Irrigation
Amount:	1.35 cfs
Season:	April 1 to June 30 and September 1 to September 30

SSWD also holds Permit 18360 (Application 26162) for appropriation from the Bear River for power purposes.

Table 2 illustrates the amount of water received from each of the surface water supplies over a five-year period (1994 – 1998). It should be noted that the volumes reported for each of the smaller local streams do not include amounts that were redistributed and conveyed from the Bear River through the SSWD distribution system from the Camp Far West Reservoir. The summary table also indicates surplus surface water deliveries from NID. These additional surface water deliveries are discussed further in Section C, “Other Water Supplies.”

B. Groundwater Supply

Following the development of SSWD’s surface water supply system in 1964, the groundwater basin underlying most of the service area has recovered from being overdrawn by 1 to 3 feet per year. Prior to the surface water development it was believed that in excess of 80,000 acre-feet per year was being extracted by private wells from the groundwater basin underlying the SSWD service area.

Currently, there are only private groundwater wells in the service area, and SSWD does not own or operate any groundwater wells. Groundwater levels drop during drought periods from continued use, but recovery rates have increased during periods of high surface water availability. Based on data available for the period of 1970 through the spring of 1993, the groundwater levels in the spring of 1993 are at approximately the same levels that existed in

1970. The groundwater levels within SSWD noticeably dropped during the drought of 1976-77 and during the extended six-year drought period of 1987 through 1992. However, groundwater levels recovered from the 1976-1977 drought to pre-drought conditions by the mid 1980s; and the groundwater levels, for the most part, appear to have recovered from the extended six-year drought. The very southeastern portion of the service area is an exception as it has not fully recovered from the increased pumping during drought periods. This area is a small portion of SSWD but needs close monitoring.

Figure 4 is a map of the SSWD service area showing lines of equal groundwater elevation in wells as of spring 1993; and Figure 5 is a map of the same area showing lines of equal groundwater depth of in wells as of spring 1993. These two maps are based on semi-annual and monthly groundwater level monitoring well data collected by SSWD and the California Department of Water Resources (DWR).

As a whole, the groundwater basin underlying the SSWD service area has been operating well as a conjunctive supply with the surface water; and the underlying basin has proven to be an important and reliable supply in times of surface water shortages. Surface water supplies are utilized as much as possible during all years; but during drier years surface water supplies are interrupted, and total irrigation demands are met by increasing groundwater extraction and cropping changes.

C. Other Water Supplies

SSWD, on a year-to-year basis, contracts with NID to purchase surplus surface water held under its pre-1914 water rights that may be available at the downstream end of NID's system. When available, historically May through September, surface water from NID is mostly conveyed through Auburn Ravine with some deliveries available from Coon Creek. Operational records from 1986 – 1998 indicate that NID has delivered an average of 7,842 acre-feet of surface water with deliveries ranging from zero during the drought year of 1988 to approximately 17,450 acre-feet during the wet year of 1996. SSWD usually places a request for surplus water with NID during April or May and outlines an anticipated monthly schedule of deliveries for the upcoming irrigation season. Reasonable adjustments in the delivery quantities during the irrigation season can be made and realized at SSWD's service area following a 48-hour notification to NID. If additional water becomes available from NID during the irrigation season, it is normally distributed and made available on a pro-rata acreage basis to all crop users within the SSWD service area.

D. Source Water Quality Monitoring Practices

SSWD has not experienced significant water quality problems from waters originating within the Bear River drainage, and currently does not have a water quality-monitoring program at this time. The main source of surface water emanates from the Bear River and is supplemented by water imported by NID via the Auburn Ravine and small amounts of water during the spring months from smaller localized streams. Upstream dischargers, such as the City of Auburn's Ophir Sewage Plant, contribute to the flows diverted out of the Auburn Ravine. The unincorporated area of Sheridan releases sewage effluent into Yankee Slough; the city of Lincoln sprinkles effluent on ground whose rainfall runoff reaches SSWD; and the city of Roseville releases treated water into Pleasant Grove Creek. Coon Creek flows also consist of return flows from upstream entities.

With the exception of the Bear River, all of the waterways within the SSWD service area, from Yankee Slough on the north to Curry Creek on the South, are located within the northern third of the Central Valley Regional Water Quality Control Board's (CVRWQCB) Drainage Basin 19 as defined in the CVRWQCB's Inland Surface Water Plan (ISWP). The ISWP was adopted by the State Water Resources Control Board to protect surface water quality, and the CVRWQCB categorized all of the natural water bodies, improved waterways, and constructed channels that are dominated by agricultural supply and drainage water. All of the drainage courses within SSWD are classified as either Category B or Category C-3 in the CVRWQCB's ISWP. Category B water bodies consist of natural water bodies dominated by either agricultural supply or drainage water; and Category C-3 water bodies are natural dry washes that have been altered and now carry agricultural supply water or return flows during defined time periods. Yankee Slough and Curry Creek have been categorized as C-3, and all other natural water body streams within the District are Category B. Figure 2 is a map of the SSWD service, which shows the location of the entire natural and improved drainage courses as well as the major surface water intakes, and surface water operational spills to and from the SSWD irrigation system. Figure 6 is a map of the SSWD irrigation system prepared in 1992 in connection with the ISWP.

SSWD attempts to operate its water delivery system with minimal spills; however, operational and seasonal spills are inherit utilizing open ditches and natural channels for conveyance facilities. Seasonal spills are also necessary for the predominant crop of rice. The Bear River Drive Pipeline, which primarily supplies water to orchards, has minimal seasonal spills returning to the Bear River. Yankee Slough surplus flows return to the Bear River channel. Ping Slough, Bertolini Drain, Line 3 Drain, and Line 3b Drain all eventually spill into Coon Creek west of the East Side Canal and thence drain into Reclamation District 1001's main canal. The Auburn Extension operational spills also drain into Coon Creek and thence into RD 1001's main canal. All other remaining operational spills within the District eventually flow to the Natomas Cross Canal. The Natomas Central Mutual Water Company and the Pleasant Grove-Verona Mutual Water Company use water within the Natomas Cross Canal.

E. Water Uses in South Sutter Water District Service Area

1. Agricultural

Table 1 depicts the agricultural uses of land under irrigation within the SSWD service area as illustrated in Figure 7. In recent years, SSWD has delivered water to as much as 29,000 acres in rice production. Irrigation of land in rice production represents approximately 82 percent of all lands (35,500 net acres) that are irrigated by SSWD surface water. Approximately 2,200 net acres of irrigated pasture make up 6 percent of the area served by SSWD; and approximately 3,800 net acres of fruit and nut orchards combine for 11 percent of the area served by SSWD, with 500 acres of miscellaneous row and field crops making up the remaining 1 percent of the 35,500 acres of lands irrigated by SSWD surface water.

2. Environmental

SSWD is required to release certain minimum flows to maintain fish life in the Bear River below the Camp Far West Diversion Dam. The SWRCB issued Licenses 11118 and 11120 (Applications 14804 and 10221, respectively) which require SSWD to maintain a minimum flow of 25 cfs during the spring months of April through June, and a minimum flow of 10 cfs during the 9 months of July through March of each succeeding year, or the inflow to the reservoir, whichever is less.

3. Recreational

The Camp Far West Reservoir has recreation facilities located within two recreational areas along the shoreline. The north facility is larger and is open to the public year round for day and overnight use. The south facility is open for day and overnight use during the months of April through October. SSWD operates the recreation facilities through a concessionaire under the administration of the Department of Water Resources. The recreational area located on the north side of the reservoir consists of 253 acres and the south recreational area comprises 110 acres. As of 1980, these two areas collectively consisted of 92 overnight campsites, plus one group overnight campsite, 108 day-use picnic sites, two day-use group picnic sites, 10 RV vehicle sites, two boat ramps, two beaches, one water treatment plant, and two sewage lagoons. Recreational activities include camping, swimming, boating, water sports, and fishing. Hunting is prohibited.

Recreation use at the reservoir is influenced by the water surface elevation of the reservoir created by the Camp Far West Dam. Historically, the reservoir is full during the spring and is drawn down throughout the summer to fulfill irrigation demands and then refills during the late fall and winter. In recent years the recreation facilities at Camp Far West Reservoir have experienced as many as 100,000 overnight visitors and over 60,000 day-use visitors.

Aside from the public recreational facilities at the Camp Far West Reservoir, no other public recreational facilities exist at or near SSWD's associated water conveyance facilities. The public has some limited access for fishing and other activities along the Bear River and the local streams where public roads run adjacent to or intersect the natural or improved watercourses.

4. Municipal and Industrial

Aside from the power plant located at the base of the Camp Far West Dam that went into commercial operation in 1985, there is an insignificant amount of water, less than 2,000 acre-feet per year, used for municipal and industrial purposes within the SSWD service area.

5. Groundwater Recharge

Under Assembly Bill No. 3030, SSWD developed a groundwater management plan to efficiently manage the groundwater resources within the SSWD area and to continue with an efficient and effective conjunctive use program. SSWD currently monitors 25 private wells on a semi-annual basis including spring and fall measurements within its boundaries and other wells within the area are monitored by DWR and the Sutter County Agricultural Commissioner.

The Camp Far West Project was developed as a conjunctive use program and provides a reliable source of surface water in most years when a full reservoir is available. Landowners are encouraged to first purchase and use available surface water and only use groundwater supplies when supplemental supplies are necessary. Operations with the Camp Far West Project in place since 1964 have replenished groundwater extracted by its landowners except in the extreme southeastern portion of SSWD. Since 1964, the recharge to the groundwater basin has been effectively accomplished from the conveyance facilities and displacement of groundwater irrigation with surface water irrigation. SSWD does not currently have any additional recharge facilities other than its existing reservoir and conveyance facilities. A copy of the District's adopted groundwater management plan is attached as Appendix 3.

6. Transfers and Exchanges

SSWD, on a year-to-year basis, contracts with NID to purchase surplus surface water held under its pre-1914 water right that may be available at the downstream end of NID's system. When available, historically from May through September, surface water from NID is mostly conveyed through the Auburn Ravine, with some deliveries available from Coon Creek. Operational records from 1986 – 1998 indicate that NID has delivered an average of 7,850 acre-feet of surface water, with deliveries ranging from zero during the drought year of 1988 to approximately 17,450 acre-feet during the wet year of 1996.

SSWD entered into a settlement agreement with the Department of Water Resources in February of 2000 for the purpose of avoiding prolonged legal process of the SWRCB Phase 8 Bay-Delta hearing. This settlement will require SSWD to release an additional 4,400 AF of water into the Bear River during dry and critical years. SSWD facilitates the transfer of surface supply entitlements within its boundaries. Water users are allowed to move water amongst their land holdings within the District's boundaries.

7. Other Uses

Irrigation water routed through the Camp Far West Reservoir passes through a 6.8 MW hydroelectric power plant located at the base of the Camp Far West Dam. Releases through the dam are primarily dependent upon variable irrigation demands and downstream fish maintenance flows. However, efforts are made to optimize energy production through the power plant without impacting downstream irrigation and fish maintenance flows.

F. Drainage from South Sutter Water District Service Area

Figure 2 is a map of the SSWD's service area which illustrates the location of all natural and improved drainage courses as well as the major surface water intakes and surface water operational spills to and from the SSWD irrigation system. Figure 6 is a map of the SSWD irrigation system prepared in connection with the District's Inland Surface Waters Plan.

The Bear River Drive Pipeline, which primarily supplies water to orchards, has minimal seasonal spills returning to the Bear River. Yankee Slough surplus flows return to the Bear River channel. Ping Slough, Bertolini Drain, Line 3 Drain, and Line 3b Drain all eventually spill into Coon Creek west of the East Side Canal and thence drain into Reclamation District 1001's main canal one mile east of Verona. The Auburn Extension operational spills also drain into Coon Creek and thence into RD 1001's main canal. All other remaining operational spills eventually flow to the Natomas Cross Canal. Water within the Natomas Cross Canal is used by the Natomas Central Mutual Water Company and the Pleasant Grove -Verona Mutual Water Company.

SSWD does not have a surface drain water quality monitoring program in place that monitors water quality levels discharged from the service area.

G. Water Accounting

1. Quantification of South Sutter Water District's Water Supplies

Table 2 provides a summary of the surface water supplies available and used by

SSWD for the period 1994 - 1998. As can be seen from the five-year average table contained in Table 2, during the 1994 - 1998 period, 88 percent of the surface water supply was developed from the Bear River. Approximately 9½ percent of the total surface water supply was provided by NID while another 2½ percent was made up from local water supplies. These local water supplies consist of the ephemeral streams traversing the SSWD service area. These local supplies comprise up-slope drain water including reclaimed or recycled water from upstream M & I users.

Table 5 presents the monthly surface water supplies and effective precipitation available and used by the District during April through October of 1998. Because groundwater is pumped by individual landowners, this data is not available to the SSWD. It is assumed that the groundwater is used to make up the difference between the available surface water and effective precipitation to meet the agricultural water cropping needs.

2. Tabulation of Water Uses

Table 6 provides an estimate of the conveyance system losses for the 1998 season. It should be noted these losses are not losses to the entire system with the exception of evaporation. The seepage losses provide groundwater recharge, and the operational spills provide water supplies for downstream irrigation districts. Table 7 provides a summary of the crop water needs for 1998.

3. Overall Water Budget

Table 8 provides the overall water budget for the 1998 season. It should be noted that estimates for Environmental Consumptive Use, Groundwater Recharge, groundwater pumping by individual users, and on-farm drain/spill water leaving the District were not computed as reasonable estimates must be based on additional data.

H. Water Supply Reliability

The surface water supply provided by SSWD is as reliable as the natural hydrologic conditions allow. The development of the surface water supply has provided increased reliability of groundwater resources available to individual water users. Therefore, the overall water supply provided jointly by SSWD and individual groundwater wells is considered to be reliable.

4. REVIEW OF PREVIOUS WATER MANAGEMENT ACTIVITIES

A. Previously Implemented Water Management Practices or EWMPs

The overall Camp Far West Project can be considered as the previously implemented water management practice by SSWD that has improved overall system reliability in order to optimize water supplies for agricultural purposes within the SSWD service area. In addition to the overall project, SSWD has continued with many maintenance and ongoing management practices to maintain the overall system integrity. These water management practices include maintenance of existing facilities by SSWD personnel and through contracts. In addition, the on-farm irrigation practices currently applied by rice growers within the Sacramento Valley have improved the overall water management of the SSWD system.

B. Current EWMP Implementation Efforts and Expected Results

In 1999, SSWD authorized MBK Engineers to undertake an overall system analysis for the purpose of increasing surface water supplies to further offset groundwater pumping. This system analysis is expected to generate a list of projects for the purpose of increasing the surface water delivery system and flexibility within the existing water rights of SSWD. It is expected that a list of projects to develop increased capacity may be determined to be cost effective, thereby offsetting the groundwater currently consumed by individual water users. This will further provide opportunities for SSWD to maximize the use of both surface and groundwater and may present opportunities for future water sales to areas of need outside of SSWD boundaries.

5. IDENTIFICATION OF EFFICIENT WATER MANAGEMENT PRACTICES

A. Generally Applicable EWMPs

1. Prepare and Adopt a Water Management Plan

SSWD's objective is to optimize the management of the available resources through short and long-term planning efforts described in this WMP. SSWD has reviewed and adopted this WMP with the intent to use it as a tool in accomplishing this objective. SSWD is determined to update the WMP in accordance with AB 3616 guidelines, thereby continuing its commitment to successfully implement all appropriate EWMPs.

2. Water Conservation Coordinator

SSWD's Water Conservation Coordinator for this WMP is Mr. Brad Arnold, General Manager of SSWD.

3. Support Availability of Water Management Services to Water Users

SSWD believes it is important to provide information on the available resources growers can utilize in daily farm operations. This includes facilitating opportunities for on-farm system evaluations, providing resources on improved irrigation scheduling techniques, and informing water users as to the programs available for increasing energy efficiency such as through the incentives offered for pump efficiency testing and repair. SSWD currently assembles general information on a regular basis that is available at the SSWD office. SSWD is committed to support the exchange of materials related to these topics and intends to provide growers with additional materials and coordinate with third parties as appropriate, through the efforts of the water conservation coordinator, to accomplish this EWMP.

4. Improve Communication and Cooperation

SSWD fundamentally believes that communication and cooperation between water users, the District, and local, state, and federal agencies is essential to effectively manage the available resources. An example of this EWMP is the coordination between SSWD and DWR in regard to the monitoring of groundwater levels in the local area. The information gathered from this data collection is shared between DWR and SSWD in order to aid in the evaluation of managing the available groundwater resources. In addition, SSWD and DWR cooperate on the releases of water pursuant to its settlement agreement. SSWD will continue to work closely with DWR and the groups listed above to enhance the operation of the Districts system.

5. Evaluate District Policies

SSWD understands that there are three basic components to a water delivery service including equity, reliability, and flexibility. When considering modifications to District policies and facilities, SSWD is aware of the significance to optimize these components. SSWD believes that it is also important to recognize the evolving demands of the water users based on improved water management practices and to incorporate the means to meet the demands by updating and enhancing District policies as necessary.

6. Evaluate and Improve Pump Efficiencies

As mentioned previously, SSWD owns and operates lift pumps that are tested on an as needed basis. SSWD intends to conduct pump efficiency tests in the future, depending on the available funding. SSWD believes that optimizing energy use efficiency may be best accomplished by evaluating and improving operational efficiency, such as with a variable frequency drive, in conjunction with pump efficiency testing.

SSWD does not own or operate any groundwater wells.

B. Facilitation EWMPs (1-4)

1. Facilitate Alternative Land Use

As defined in Appendix A of the MOU, the facilitation of voluntary compensated land use is to assist in the control of problem drainage. The soils section of this WMP indicate that the soils within SSWD are generally well drained, and therefore do not exhibit areas of inadequate drainage. In addition, it is outside of SSWD's authority to take action to facilitate alternative land uses. Land use changes are made by individual landowners. SSWD provides surface water to users within its boundaries that are in good standing through compliance with rules and regulations. SSWD does nothing to deter land use changes. SSWD would deliver water to lands that make alternative uses if it was compliant with existing rules and regulations.

For the reasons identified above, this EWMP is considered demonstrably inappropriate.

2. Facilitate Use of Available Recycled Water

Upstream M & I water users release treated effluent into local channels that flow through SSWD. This water is diverted by SSWD pursuant to its water rights as part of the overall water supply. There is no recycled water generated within SSWD boundaries. Therefore, all available recycled water is used by SSWD, and this EWMP is fully implemented.

3. Facilitate Financial Assistance

SSWD provides no direct financial assistance to its water users. SSWD intends to have its Water Conservation Coordinator develop a list of available financial aid to farmers with assistance from DWR that will be available to District water users. This list should include funding source (grant or loan) procedures, potential future requirements, and water user contact name and phone number. The list is scheduled for compilation and distribution by December 2004. Therefore, SSWD accepts this EWMP for implementation.

4. Facilitate Voluntary Water Transfers

SSWD currently facilitates and promotes voluntary water transfers amongst single farm units based on ownership within its service area. This means that, for example, a farming corporation may fully irrigate a crop on a particular field with surface water using the combined allocations from other fields owned by the corporation. The other fields are fallowed or irrigated with groundwater. Records of past voluntary surface water transfers are not maintained by SSWD. Voluntary surface water transfers between different landowners are not permitted. During drought periods, SSWD permits the flexibility to convey groundwater through SSWD facilities, if capacity is available, for use amongst single farm units based on ownership. Therefore, this EWMP has been fully implemented.

C. EWMPs (5-11) with Detailed Analysis

1. Line or Pipe Ditches and Canals

This EWMP is currently being implemented to a satisfactory level, as lining and piping occur to meet operational requirements and conditions. It is not appropriate for this EWMP to be implemented extensively as the surface water delivery system helps meet groundwater recharge for this conjunctive use system; the conveyance losses account for approximately 6,000 AF per year of recharge. The lining or piping of the ditches and canals may have adverse environmental impacts to those natural canals and laterals within the SSWD.

2. Increase Water Ordering/Delivering Flexibility

SSWD believes this EWMP is satisfactorily implemented. SSWD allocates only a partial surface water supply to its water users; and because of the delivery system characteristics, it is believed flexibility is at a peak. Water ordering for the subsequent day has proven satisfactory for its water users for many years. This daily requirement provides SSWD the necessary time to make adjustments at its diversion facilities and to assure the changes are effective throughout the system.

3. Construct/Operate Tail Water and Spill Recovery System

SSWD staff operates the facilities to minimize tail water and spill at eight sites leaving SSWD. Individual water user facilities are able to capture and use tail water internal to SSWD. Because these sites are used as an operational guide, SSWD believes this EWMP is fully implemented and that there is no additional opportunity to capture water leaving SSWD boundaries. However, SSWD lacks data to support its belief and intends to take appropriate action to support its position. This is further described under EWMP #10.

4. Optimize Conjunctive Use

The objective behind the construction of Camp Far West Reservoir is to reduce groundwater extraction and to provide in-lieu groundwater recharge by supplying water users with a partial surface water supply. For this reason, SSWD believes this EWMP has been implemented to a satisfactory level. SSWD continues to seek opportunities to increase surface water deliveries to offset potential adverse impacts to the groundwater basin and reduce overall water supply costs for water users.

SSWD is currently undertaking a project to improve diversion efficiency in its main canal. This project will allow SSWD to increase the rate of flow through its main canal to accommodate increased deliveries from Camp Far West Reservoir during wetter years. This potential benefit is intended to offset the surface water made available during dryer years under its Bay-Delta Settlement Agreement with the DWR. The Settlement Agreement and the Canal Improvement Project provide direct benefit to the Delta.

5. Automate Canal Structures

SSWD accepts the EWMP and intends to gather data on the quantity of water leaving the District through EWMP #10. The resulting data will allow SSWD to evaluate the potential benefit from automating the canal structures.

6. Water Measurement / Water Use Update

SSWD currently measures water to each customer to assure equitable distribution of the available surface water supply. These flow measurements are gathered from propeller flow meters and water level data using a theoretical rating for a weir structure. This equipment was calibrated before or at the time of installation and is estimated to provide a flow rate of within +/-10 percent of the actual flow. Recalibration of these measurement devices will depend on the funding available. Updated water use reports are provided to water users midway through the irrigation season to advise of water use and applicable charges for payment to SSWD.

SSWD accepts this EWMP and will continue to implement the water measurement objectives under its current policies and authority through the assessment of the various spill sites in order to develop a summary package identifying locations of improved flow measurement and methods to facilitate funding acquisitions. The resulting data from this EWMP will prompt the detailed evaluation of EWMPs #7 and #9. The estimated schedule and costs to accomplish the reconnaissance level investigation for this EWMP are detailed further in this WMP.

7. Pricing and Incentives

SSWD establishes prices based on available surface water supplies in a manner to cover its costs and provide an appropriate operational reserve fund. An example of the rate structure is provided in Appendix 2 of this WMP. Considering SSWD provides only partial water supplies to its users and desires to maximize surface water deliveries in order to maintain groundwater conditions, price incentives are not appropriate. In essence, SSWD prices its water at the minimum price to facilitate maximum surface water use. Therefore, there is no opportunity to adopt price incentives.

6. SCHEDULES, BUDGETS, AND PROJECTED RESULTS

Schedule

EWMP #3: SSWD will obtain or develop a summary of financial assistance and distribute to its landowners by December 2004.

EWMP #7, #9, and #10:

1. SSWD intends to perform a reconnaissance level investigation of the various spill sites by August 2004.

2. By November 2004, SSWD will prepare a summary package and estimated range of costs for developing improved measurement at the designated sites to facilitate the acquisition of funding.

3. The next step is to locate available funding to construct and install the appropriate facilities. The schedule will depend upon the extent of flow measurement analysis and available funding.

Budget

EWMP #3: The expected cost to implement this EWMP is expected to be minimal, less than $2,500.

EWMP #7, #9, and #10:

1.	Reconnaissance Field Visit (including documentation):	$ 3,000
2.	Summary Document:	$ 5,000
3.	Alternative Cost Estimates:	$10,000
4.	Search for Available Funds:	$ 3,000
		$21,000

Projected Results

EWMP #3: Education of available financial assistance to growers.

EWMP #7, #9, and #10: Develop a data gathering plan or strategy to evaluate the appropriateness of EWMPs #7, #9, and #10.

7. REVIEW, EVALUATION, AND ADOPTION OF WATER MANAGEMENT PLAN

SSWD has reviewed and formally adopted this WMP as part of the District's strategy to enhance overall system management. The District intends to update the WMP in accordance with AB 3616 guidelines, thereby continuing the commitment to successfully implement all appropriate EWMPs.

8. IMPLEMENTATION OF JUSTIFIED EFFICIENT WATER MANAGEMENT PRACTICES

As described in Section 4 of this WMP, EWMP #1 is demonstrably inappropriate and EWMPs #2, #4 – #8, and #11 are considered to be successfully implemented. EWMP #3 is scheduled for successful implementation by December 2004 whereby the District will disseminate information regarding financial assistance to water users.

Short term, the District is developing a data gathering strategy as part of EWMP #10 to evaluate the appropriateness of EWMPs #7 and #9 as outlined in Section 6 of this WMP. Long term, the District anticipates that each appropriate EWMP will be successfully implemented in some manner.

9. MONITOR, EVALUATE, AND UPDATE WATER MANAGEMENT PLAN

SSWD intends to adhere to the implementation schedule of justified EWMPs outlined in Section 6. The schedule specifically addresses EWMPs #3 and #10. The results of EWMP #10 will facilitate the further evaluation of EWMPs #7, and #9. SSWD remains committed to maximizing surface water use to offset the effect of groundwater pumping by ensuring the flexibility in implementation of the EWMPs. The status and success of the implementation process will be documented in the progress reports to this WMP.

The major constraint to implement the justified EWMPs is funding. SSWD will seek funding opportunities upon acceptance of proposed site modifications.

LIST OF TABLES

TO

SOUTH SUTTER WATER DISTRICT

WATER MANAGEMENT PLAN

TABLE 1

Historical Use of Irrigated Lands within South Sutter Water District

Year	Rice		Irrigated Pasture		Fruit Orchards		Nut Orchards		Corn / Sudan		Beans		Alfalfa or Clover		Tomatoes		Other Vegetables		Total Acreage Irrigated
	Acres	% of Total	Acres	% of Total	Acres	% of Total	Acres	% of Total	Acres	% of Total	Acres	% of Total	Acres	% of Total	Acres	% of Total	Acres	% of Total	
1950	10,319	55	3,655	20	1,076	6	2,156	12	174	1	260	1	490	3	373	2	90	0	18,593
1956	10,925	52	4,160	20	1,027	5	2,053	10	1,155	6	340	2	1,145	5	150	1	-	-	20,955
Ave 1950's	10,622	54	3,908	20	1,052	5	2,105	11	665	3	300	2	818	4	262	1	45	0	19,774
1986	22,270	80	2,245	8	*1,065*	4	*2,131*	8	80	0	-	-	200	1	-	-	-	-	27,991
1987	19,900	75	2,355	9	*1,166*	4	2,332	9	576	2	-	-	100	0	-	-	-	-	26,429
1988	18,990	76	2,100	8	1,250	5	2,300	9	300	1	-	-	200	1	-	-	-	-	25,140
1989	20,000	77	2,100	8	1,250	5	2,300	9	*300*	1	*30*	0	80	0	-	-	-	-	26,060
1990	22,000	79	2,200	8	1,250	4	2,240	8	250	1	20	0	-	-	-	-	-	-	27,960
1991	25,000	82	1,864	6	674	2	2,743	9	341	1	-	-	-	-	-	-	-	-	30,622
1992	25,807	85	1,449	5	767	3	1,925	6	512	2	-	-	-	-	-	-	-	-	30,460
1993	25,829	83	1,448	5	785	3	2,200	7	373	1	-	-	139	0	-	-	302	1	31,076
1994	28,300	87	1,400	4	760	2	1,900	6	300	1	-	-	-	-	-	-	-	-	32,660
1995	29,391	83	2,177	6	757	2	2,588	7	218	1	127	0	-	-	-	-	-	-	35,258
1996	29,430	83	2,177	6	757	2	2,588	7	264	1	120	0	-	-	-	-	-	-	35,336
1997	29,179	82	2,177	6	1,271	4	2,538	7	285	1	195	1	-	-	-	-	-	-	35,645
1998	29,000	82	2,177	6	1,271	4	2,540	7	300	1	200	1	40	0	-	-	-	-	35,528
13-Yr Ave 1986-1998	25,007	81	1,990	7	1,002	3	2,333	8	315	1	53	0	58	0	-	-	23	0	30,782

TABLE 2

SSWD Surface Water Supplies: 1994 - 1998
(acre-feet)

1994	SSWD Surface Water Supplies (Acre-Feet)							
	SSWD Canal (Bear River)	NID Deliveries	Yankee Slough	Auburn - Coppin Dam	Coon Creek	Pleasant - Curry	Total w/o NID	Total w/NID
JAN	-	-	-	-	-	-	-	-
FEB	-	-	-	-	-	-	-	-
MAR	-	-	-	-	-	-	-	-
APR	7,277	-	16	-	154	-	7,447	7,447
MAY	15,473	768	-	-	335	-	15,808	16,576
JUN	15,390	1,150	-	-	86	-	15,476	16,625
JUL	15,080	2,035	-	-	98	-	15,178	17,213
AUG	14,727	1,434	-	-	310	-	15,037	16,471
SEP	4,108	-	7	289	41	-	4,445	4,445
OCT	-	-	-	-	-	-	-	-
NOV	-	-	-	-	-	-	-	-
DEC	-	-	-	-	-	-	-	-
Total	72,055	5,386	23	289	1,024	-	73,391	78,777

1995	SSWD Surface Water Supplies (Acre-Feet)							
	SSWD Canal (Bear River)	NID Deliveries	Yankee Slough	Auburn - Coppin Dam	Coon Creek	Pleasant - Curry	Total w/o NID	Total w/NID
JAN	-	-	-	-	-	-	-	-
FEB	-	-	-	-	-	-	-	-
MAR	-	-	-	-	-	-	-	-
APR	996	-	-	-	43	-	1,039	1,039
MAY	16,997	596	8	-	424	-	17,428	18,024
JUN	19,839	1,523	-	-	883	-	20,722	22,245
JUL	23,673	2,982	-	-	1,118	-	24,791	27,773
AUG	23,530	2,934	-	-	1,103	-	24,633	27,567
SEP	11,171	266	8	1,440	325	-	12,943	13,209
OCT	2,479	-	10	344	-	-	2,833	2,833
NOV	-	-	-	-	-	-	-	-
DEC	-	-	-	-	-	-	-	-
Total	98,685	8,301	25	1,784	3,896	-	104,389	112,690

1996	SSWD Surface Water Supplies (Acre-Feet)							
	SSWD Canal (Bear River)	NID Deliveries	Yankee Slough	Auburn - Coppin Dam	Coon Creek	Pleasant - Curry	Total w/o NID	Total w/NID
JAN	-	-	-	-	-	-	-	-
FEB	-	-	-	-	-	-	-	-
MAR	-	-	-	-	-	-	-	-
APR	1,225	-	-	-	-	-	1,225	1,225
MAY	18,462	2,427	7	-	94	-	18,563	20,989
JUN	25,460	2,991	-	-	500	-	25,960	28,951
JUL	26,664	6,544	-	-	953	-	27,617	34,161
AUG	26,061	5,485	-	-	1,011	-	27,072	32,557
SEP	8,485	-	6	687	423	-	9,601	9,601
OCT	3,736	-	4	-	-	-	3,740	3,740
NOV	-	-	-	-	-	-	-	-
DEC	-	-	-	-	-	-	-	-
Total	110,093	17,446	16	687	2,980	-	113,776	131,223

TABLE 2

SSWD Surface Water Supplies: 1994 - 1998
(acre-feet)

1997	SSWD Surface Water Supplies (Acre-Feet)							
	SSWD Canal (Bear River)	NID Deliveries	Yankee Slough	Auburn - Coppin Dam	Coon Creek	Pleasant - Curry	Total w/o NID	Total w/NID
JAN	-	-	-	-	-	-	-	-
FEB	-	-	-	-	-	-	-	-
MAR	-	-	-	-	-	-	-	-
APR	7,440	-	-	142	309	-	7,891	7,891
MAY	23,790	1,325	7	302	728	-	24,827	26,152
JUN	25,177	1,808	-	-	564	68	25,808	27,616
JUL	26,222	5,744	-	-	-	-	26,222	31,966
AUG	22,782	3,240	-	-	397	-	23,179	26,419
SEP	5,974	-	3	172	88	-	6,238	6,238
OCT	2,465	-	3	-	-	3	2,471	2,471
NOV	-	-	-	-	-	-	-	-
DEC	-	-	-	-	-	-	-	-
Total	113,850	12,116	13	616	2,086	71	116,636	128,753

1998	SSWD Surface Water Supplies (Acre-Feet)							
	SSWD Canal (Bear River)	NID Deliveries	Yankee Slough	Auburn - Coppin Dam	Coon Creek	Pleasant - Curry	Total w/o NID	Total w/NID
JAN	-	-	-	-	-	-	-	-
FEB	-	-	-	-	-	-	-	-
MAR	-	-	-	-	-	-	-	-
APR	127	-	-	-	-	-	127	127
MAY	15,436	-	-	63	-	-	15,499	15,499
JUN	18,456	-	-	735	-	-	19,191	19,191
JUL	27,054	6,162	-	-	-	-	27,054	33,216
AUG	26,381	4,322	-	-	-	-	26,381	30,703
SEP	11,479	20	-	473	-	-	11,952	11,972
OCT	3,620	-	-	35	-	-	3,655	3,655
NOV	-	-	-	-	-	-	-	-
DEC	-	-	-	-	-	-	-	-
Total	102,553	10,504	-	1,305	-	-	103,858	114,362

5 Year Average (1994 - 1998)	SSWD Surface Water Supplies (Acre-Feet)							
	SSWD Canal (Bear River)	NID Deliveries	Yankee Slough	Auburn - Coppin Dam	Coon Creek	Pleasant - Curry	Total w/o NID	Total w/NID
JAN	-	-	-	-	-	-	-	-
FEB	-	-	-	-	-	-	-	-
MAR	-	-	-	-	-	-	-	-
APR	3,413	-	3	28	101	-	3,546	3,546
MAY	18,032	1,023	4	73	316	-	18,425	19,448
JUN	20,864	1,494	-	147	406	14	21,431	22,926
JUL	23,739	4,693	-	-	434	-	24,172	28,866
AUG	22,696	3,483	-	-	564	-	23,260	26,743
SEP	8,243	57	5	612	175	-	9,036	9,093
OCT	2,460	-	3	76	-	1	2,540	2,540
NOV	-	-	-	-	-	-	-	-
DEC	-	-	-	-	-	-	-	-
Total	99,447	10,751	16	936	1,997	14	102,410	113,161

TABLE 3
SOUTH SUTTER WATER DISTRICT – AGRICULTURAL IRRIGATION SYSTEM

Facility Designation	Type	Construction	Length (miles)		
			Reconstructed Channel	Natural	Constructed
Conveyance Canal	Constructed	Earth Lined			5.5
Bear River Drive Canal	Constructed	Earth Lined			2.5
Bear River Drive Pipeline	Constructed	Pipeline			5.8
Line 1	Constructed	Earth Lined			16.1
Line 2	Constructed	Earth Lined			5.6
Line 3	Constructed	Earth Lined			6.9
Line 3B	Constructed	Earth Lined			3.1
Line 4A	Constructed	Earth Lined			5.2
Line 4B	Constructed	Earth Lined			1.6
English Canal	Constructed	Earth Lined			3.3
English Extension	Constructed	Earth Lined			1.0
Buck Ditch	Constructed	Earth Lined			0.8
Line 7	Constructed	Earth Lined			1.0
Line 1A	Constructed	Earth Lined			0.4
Bertolini Drain	Constructed	Earth Lined			2.4
Auburn Extension	Constructed	Earth Lined			3.5
East Side Canal	Constructed	Earth Lined			2.9
Coon Creek Drain	Constructed	Earth Lined			2.1
Line 3B Drain	Constructed	Earth Lined			3.2
Auburn Ravine	Natural/ Constructed	Earth Lined	2.1	4.4	
Warren Pacific Drain	Constructed	Earth Lined			2.2
Yankee Slough	Natural/ Constructed	Earth Lined	0.5	9.9	
Coon Creek	Natural/ Constructed	Earth Lined	1.0	9.4	
Bunkham Ravine	Natural/ Constructed	Earth Lined	1.1	4.3	
Markham Ravine	Natural/ Constructed	Earth Lined	1.6	6.8	
King Slough	Natural/ Constructed	Earth Lined	0.9	3.0	
Pleasant Grove Creek	Natural	Earth Lined	1	2.2	
Ping Slough	Natural	Earth Lined		1.4	

Table 4

Soils Summary
South Sutter Water District

Placer County, 1973 Survey

Soil Class	Total Acres
104 - Alamo-Fiddyment complex, 0-5% slopes	1,206
140 - Cometa sandy loam, 1-5% slopes	291
141 - Cometa-Fiddyment complex, 1-5% slopes	4,299
142 - Cometa-Ramona sandy loams, 1-5% slopes	236
146 - Fiddyment loam, 1-8% slopes	1,001
147 - Fiddyment-Kaseberg loams, 2-9% slopes	78
162 - Kilaga loam	1,580
174 - Ramona sandy loam, 0-2% slopes	196
175 - Ramona sandy loam, 2-9% slopes	9
176 - Redding and Corning gravelly loams, 2-9% slopes	314
178 - Riverwash	14
181 - San Joaquin sandy loam, 1-5% slopes	4,102
182 - San Joaquin-Cometa sandy loams, 1-5% slopes	4,692
192 - Xerofluvents, sandy	131
193 - Xerofluvents, occasionally flooded	528
194 - Xerofluvents, frequently flooded	488
w - Water surface	31
Total:	**19,194**

Sutter County, 1982 Survey

Soil Class	Total Acres
104 - Capay silty clay, 0-2% slopes	7,934
105 - Capay silty clay, occasionally flooded, 0-2% slopes	2,390
109 - Capay clay, hardpan substratum, 0-2% slopes	76
110 - Clear Lake silt loam, 0-2% slopes	229
111 - Clear Lake silt loam, frequently flooded, 0-2% slopes	329
112 - Clear Lake clay, 0-2% slopes	61
117 - Columbia fine sandy loam, 0-2% slopes	1,321
119 - Columbia fine sandy loam, clay substratum, 0-2% slopes	85
121 - Columbia fine sandy loam, frequently flooded, 0-2% slopes	216
123 - Cometa loam, 0-2% slopes	11,434
128 - Exeter sandy loam, 0-2% slopes	233
129 - Galt clay, 0-2% slopes	810
130 - Galt clay, frequently flooded, 0-2% slopes	406
132 - Gridley clay loam, 0-1% slopes	66
133 - Holillipah loamy sand, 0-2% slopes	1,251
134 - Holillipah loamy sand, channeled, 0-2% slopes	244
135 - Holillipah loamy sand, frequently flooded, 0-2% slopes	231
136 - Holillipah sandy loam, 0-2% slopes	238
140 - Marcum clay loam, 0-2% slopes	3,040
141 - Marcum clay loam, siltstone substratum, 0-1% slopes	626
142 - Marcum clay loam, occasionally flooded, 0-2% slopes	687
144 - Nueva loam, 0-1% slopes	577
145 - Nueva loam, occasionally flooded, 0-1% slopes	753
158 - San Joaquin sandy loam, 0-2% slopes	7,905

Table 4

Soil Class	Total Acres
159 - San Joaquin sandy loam, occasionally flooded, 0-2% slopes	1,152
162 - Shanghai silt loam, 0-2% slopes	990
163 - Shanghai silt loam, clay substratum, 0-2% slopes	11
164 - Shanghai silt loam, clay substratum, frequently flooded, 0-2% slopes	97
165 - Shanghai silt loam, frequently flooded, 0-2% slopes	17
168 - Shanghai Variant loamy sand, 0-1% slopes	84
169 - Snelling loam, 0-2% slopes	1,417
170 - Snelling loam, occasionally flooded, 0-2% slopes	1,935
174 - Tisdale clay loam, 0-2% slopes	37
175 - Yuvas loam, 0-2% slopes	2
w - Water surface	54
Total:	**46,939**

Total from Placer County:	**19,194**	
Total from Sutter County	**46,939**	
Total in the District:	**66,133**	**Acres**

Table 5				
1998 Water Supplies				
Month	**Surface water[1] (acre-feet)**	**Groundwater[2] (acre-feet)**	**Effective precipitation[3] (acre-feet)**	**Total (acre-feet)**
April	127		3,185	3,312
May	15,499		3,700	19,199
June	19,191		30	19,221
July	33,216		0	33,216
August	30,703		0	30,703
September	11,972		574	12,546
October	3,655		1,646	5,301
Total	**114,362**		**9,135**	**123,497**

[1] Surface water data from Table 2.

[2] Quantities of groundwater pumped are unknown by SSWD. Wells are privately owned and operated.

[3] Calculated as 51% of the rainfall occurring during the given month on the planted acres of 35,528 acres (Table 1). Precipitation data from Nicholas 2 Station, National Climatic Data Center.

Table 6					
1998 Conveyance System Losses					
Reach or Lateral	**Length[1] (miles)**	**Seepage[2] (acre-feet)**	**Evaporation[3] (acre-feet)**	**Operational spills[4] (acre-feet)**	**Total losses (acre-feet)**
Constructed/Earth-Lined (SSWD Canal - Bear River)	69.3	5,130	190	—	5,320
Natural and Constructed/Earth-Lined	49.6	590	270	—	860
Coppin Dam - Terminus of SSWD Control	—	—	—	—	—
Total	**118.9**	**5,720**	**460**	---	**6,180**

[1] Length of reach or lateral from Table 3.

[2] Conveyance system seepage was estimated at 5% of the total supply, Table 2.

[3] Evaporation from the conveyance system was estimated using an average width of 7.5 feet for the constructed/earth-lined reaches, and 15 feet for the natural and constructed/earth lined reaches, and an evaporation rate of 3.0 acre-feet per acre.

[4] Spill sites are to be evaluated under EWMP #10 to implement flow measurement technologies.

Table 7							
1998 Total Crop Water Needs							
Crop	**Crop area[1] (acres)**	**Planting[2] month**	**Harvest[2] month**	**Crop ET[3] (AF per acre)**	**Leaching requirement[4] (AF per acre)**	**Cultural practices[5] (AF per acre)**	**Total crop water needs[6] (AF)**
Rice	29,000			3.5	0.35	1.25	147,900
Pasture	2,177			3.6	0.36	--	8,621
Fruit Orchards[7]	1,271			3.2	0.32	--	4,474
Nut Orchards[8]	2,540			3.2	0.32	--	8,941
Corn/Sudan	300			2.0	0.20	--	660
Bean	200			1.4	0.14	--	308
Alfalfa or Clover	40			3.5	0.35	--	154
All Other Miscellaneous	0			--	--	--	--
Total	**35,528**						**171,058**

1 Crop area data from Table 1.

2 Planting and harvest dates are not provided to SSWD by the water user.

3 Source is Table 23, page 37 of DWR Bulletin 113-3, 1974.

4 Leaching requirement is estimated to be 10% of published Crop ET.

5 Cultural practices assumed for rice of 1.25 AF/acre is consistent with USBR's method for determining water need.

6 Total crop water needs = { Crop ET + Leaching requirement + Cultural practices } x Crop area

7 Fruit Orchards ET = Deciduous Orchard ET from DWR Bulletin 113-3

8 Nut Orchards ET = Deciduous Orchard ET from DWR Bulletin 113-3

Table 8

1998 Overall Water Budget[1]
(acre-feet)

District Beneficial Uses				
Total Crop Water Needs	(Table 7)		171,058	
Environmental Consumptive Use[2]		minus		
Groundwater Recharge[2]		minus		
Effective Precipitation	(Table 5)	minus	9,135	
Water Exchanges or Transfers		plus or minus	0	
	Total Crop Irrigation Water Needs			161,923
Total Surface Water Supply	(Table 5)		114,362	
District Non-Beneficial Uses				
Conveyance System Seepage[3]	(Table 6)	minus	5,720	
Conveyance System Evaporation	(Table 6)	minus	460	
Conveyance System Spills[3, 4]	(Table 6)	minus		
Consumptive Use by Riparian Vegetation[2]		minus		
	Total Available Surface Water Supply for Users			108,182
On-farm Drain/Spill Water Leaving the District[2]		minus		
Deep Percolation[5]		EQUALS		

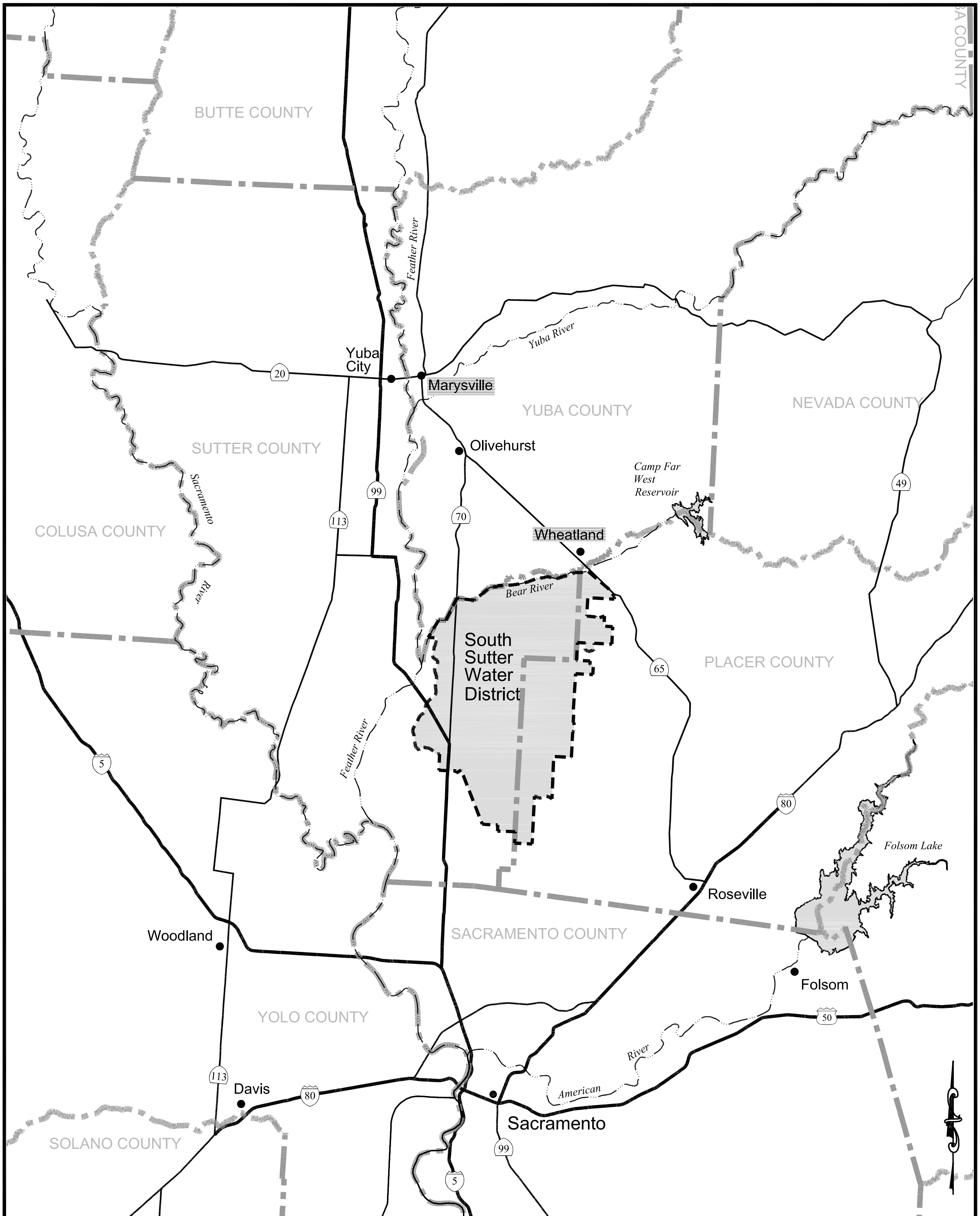
1 Overall Water Budget does not include an estimate of groundwater pumped by individual water users.
2 No estimates are calculated by SSWD.
3 Although seepage and spill are identified as District non-beneficial uses, this was not lost to the overall system and is available for other and later beneficial uses.
4 Spill sites are to be evaluated under EWMP #10 to implement flow measurement technologies.
5 Reasonable deep percolation estimates may be calculated after implementation of EWMP #10.

LIST OF FIGURES

TO

SOUTH SUTTER WATER DISTRICT

WATER MANAGEMENT PLAN



MBK ENGINEERS
2450 Alhambra Boulevard, 2nd Floor
Sacramento, California 95817
Phone: (916) 456-4400 • Fax: (916) 456-0253

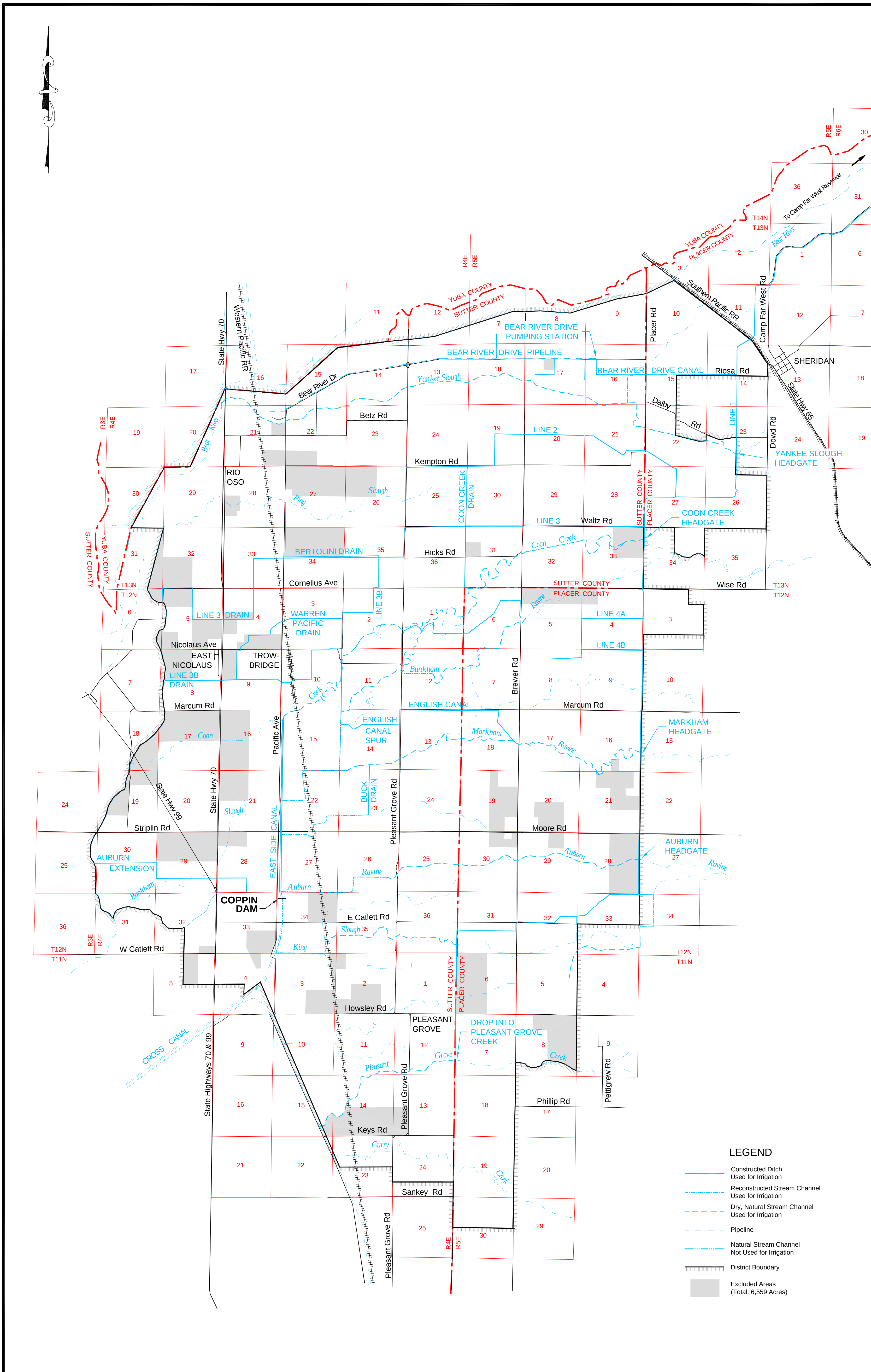
South Sutter Water District

LOCATION MAP

SCALE:	1 : 500,000
JOB NUMBER:	5025
DRAWN BY:	RS
DATE:	November 2003

Bar Length On Original Drawing Equals One Inch. Adjust Scale Accordingly

Figure 1



MBK ENGINEERS

2450 Alhambra Boulevard, 2nd Floor
Sacramento, California 95817
(916) 456-4400

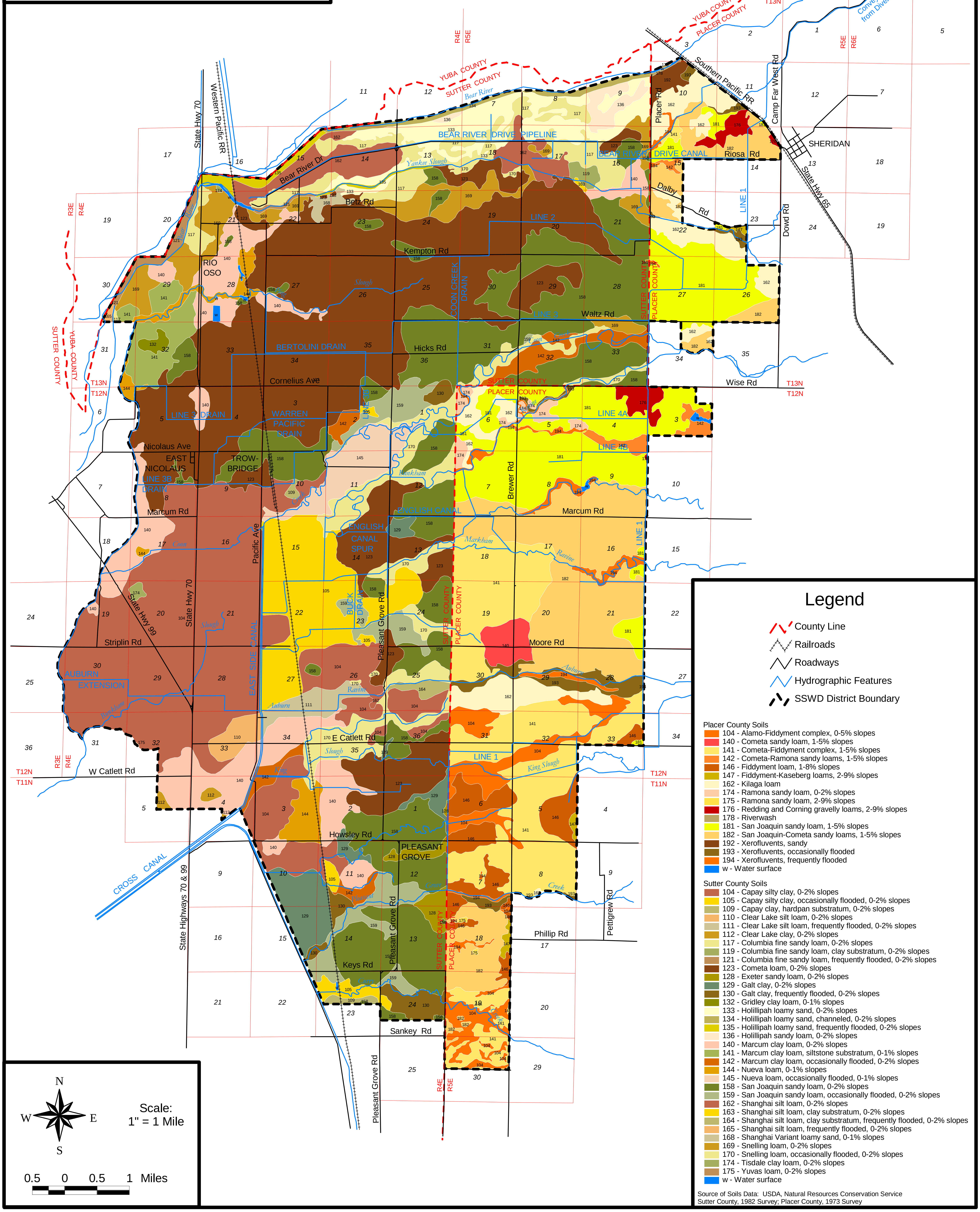
South Sutter Water District

BOUNDARY & SURFACEWATER DISTRIBUTION SYSTEM

0 2000 4000 6000 8000
Scale in Feet

Figure 2

Figure 3
South Sutter Water District
Soil Classification Map



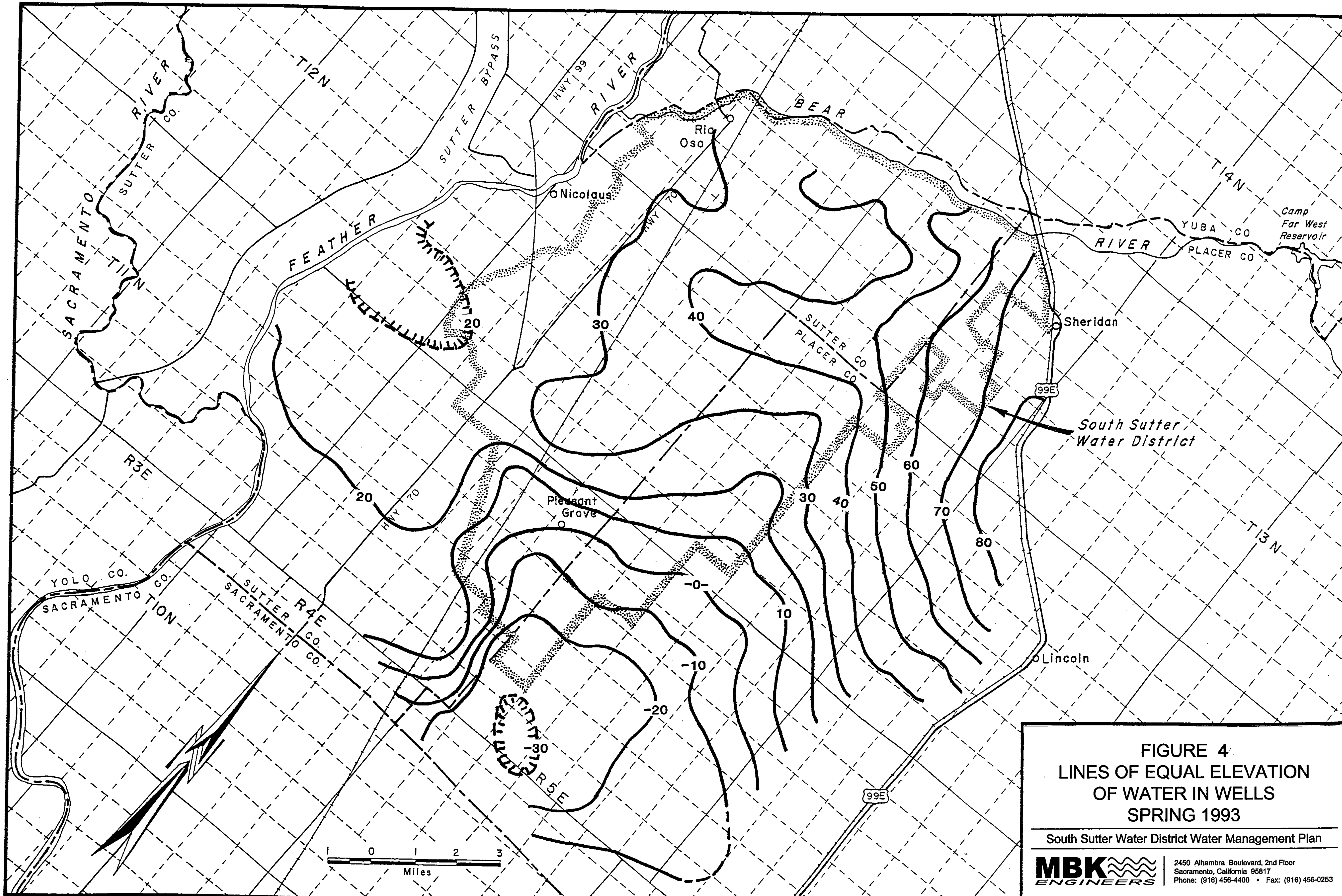


FIGURE 4
LINES OF EQUAL ELEVATION
OF WATER IN WELLS
SPRING 1993

South Sutter Water District Water Management Plan

MBK ENGINEERS
2450 Alhambra Boulevard, 2nd Floor
Sacramento, California 95817
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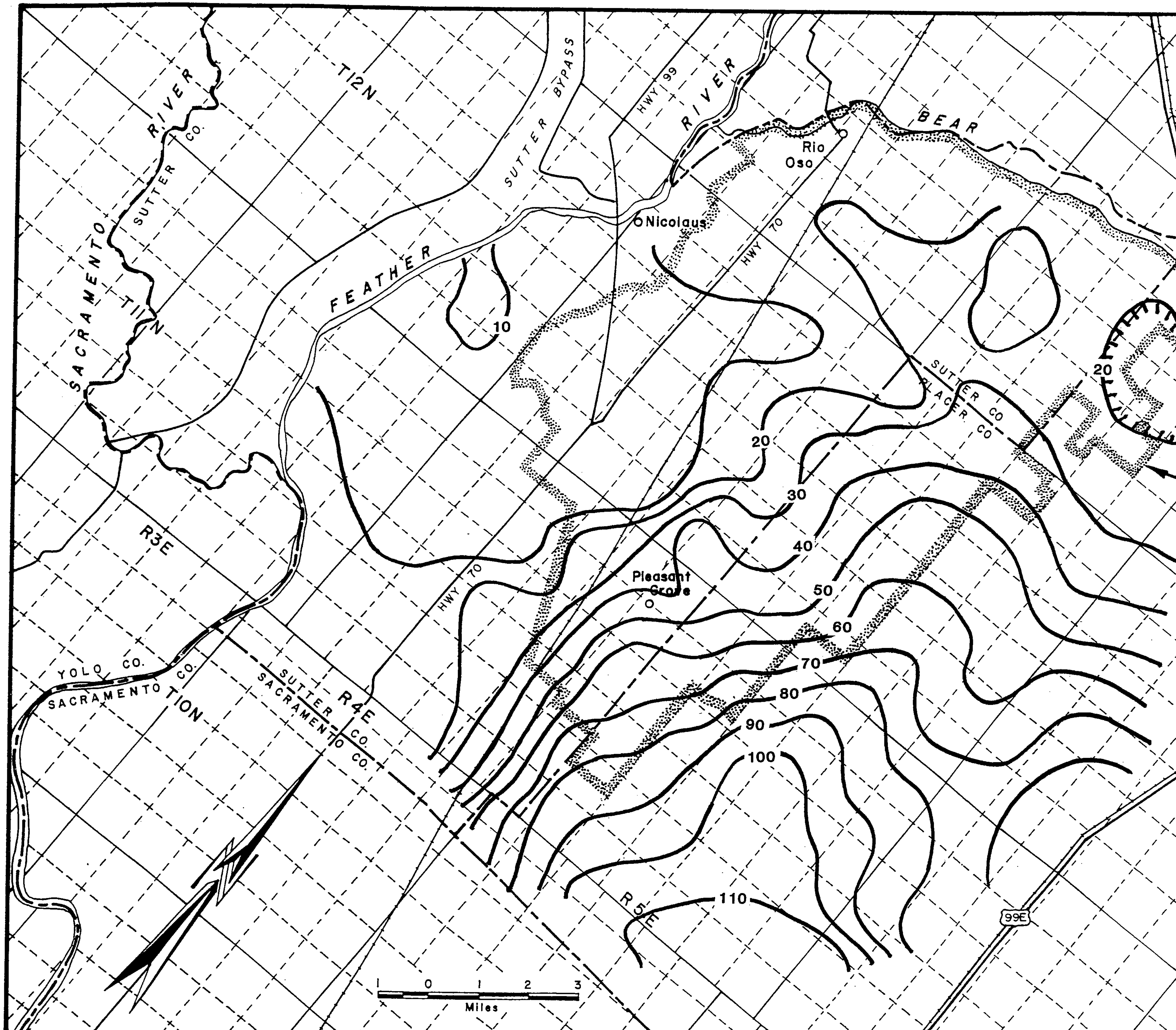


FIGURE 5
LINES OF EQUAL DEPTH OF WATER IN WELLS SPRING 1993

South Sutter Water District Water Management Plan

MBK ENGINEERS
2450 Alhambra Boulevard, 2nd Floor
Sacramento, California 95817
Phone: (916) 456-4400 • Fax: (916) 456-0253

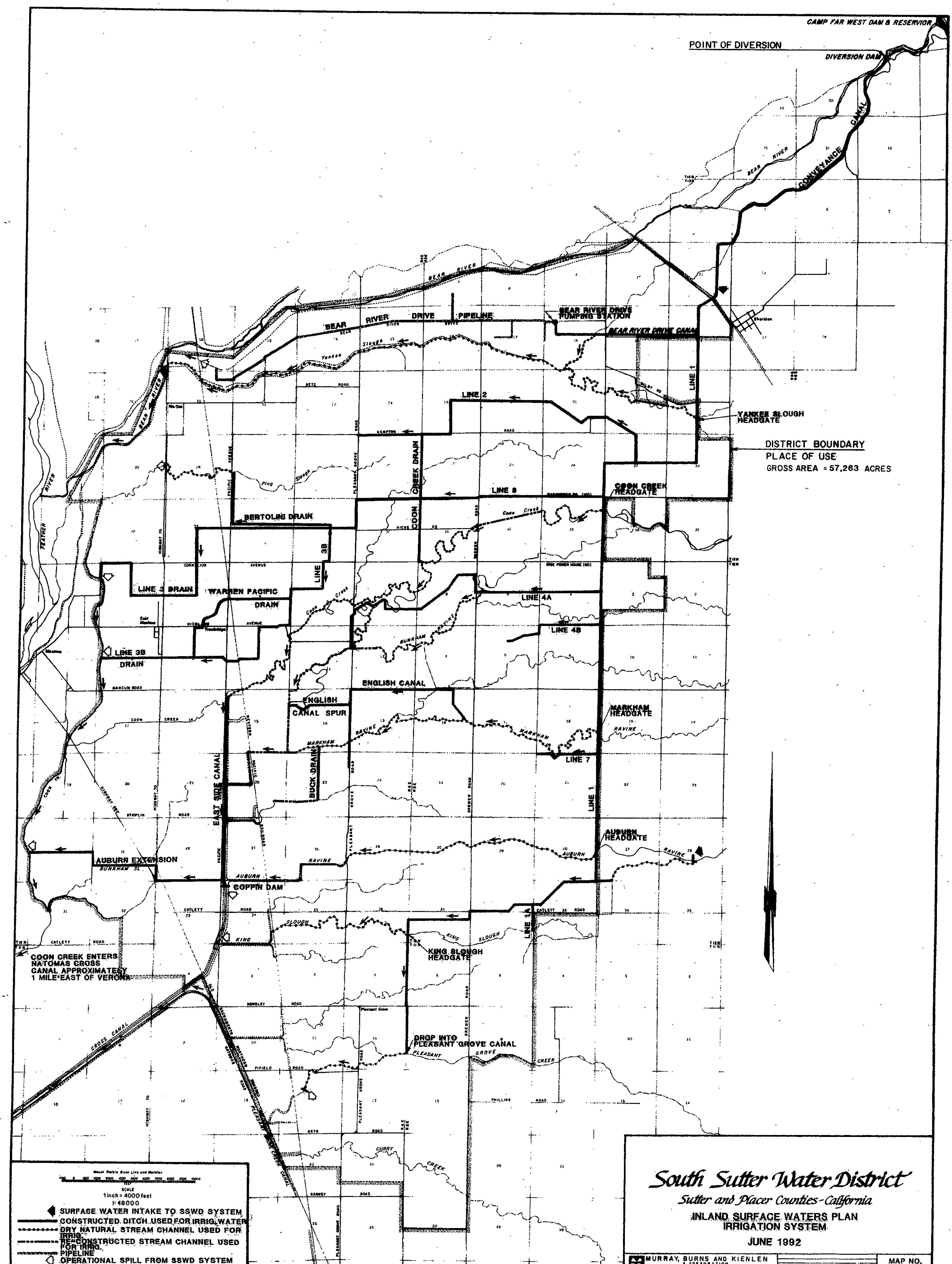
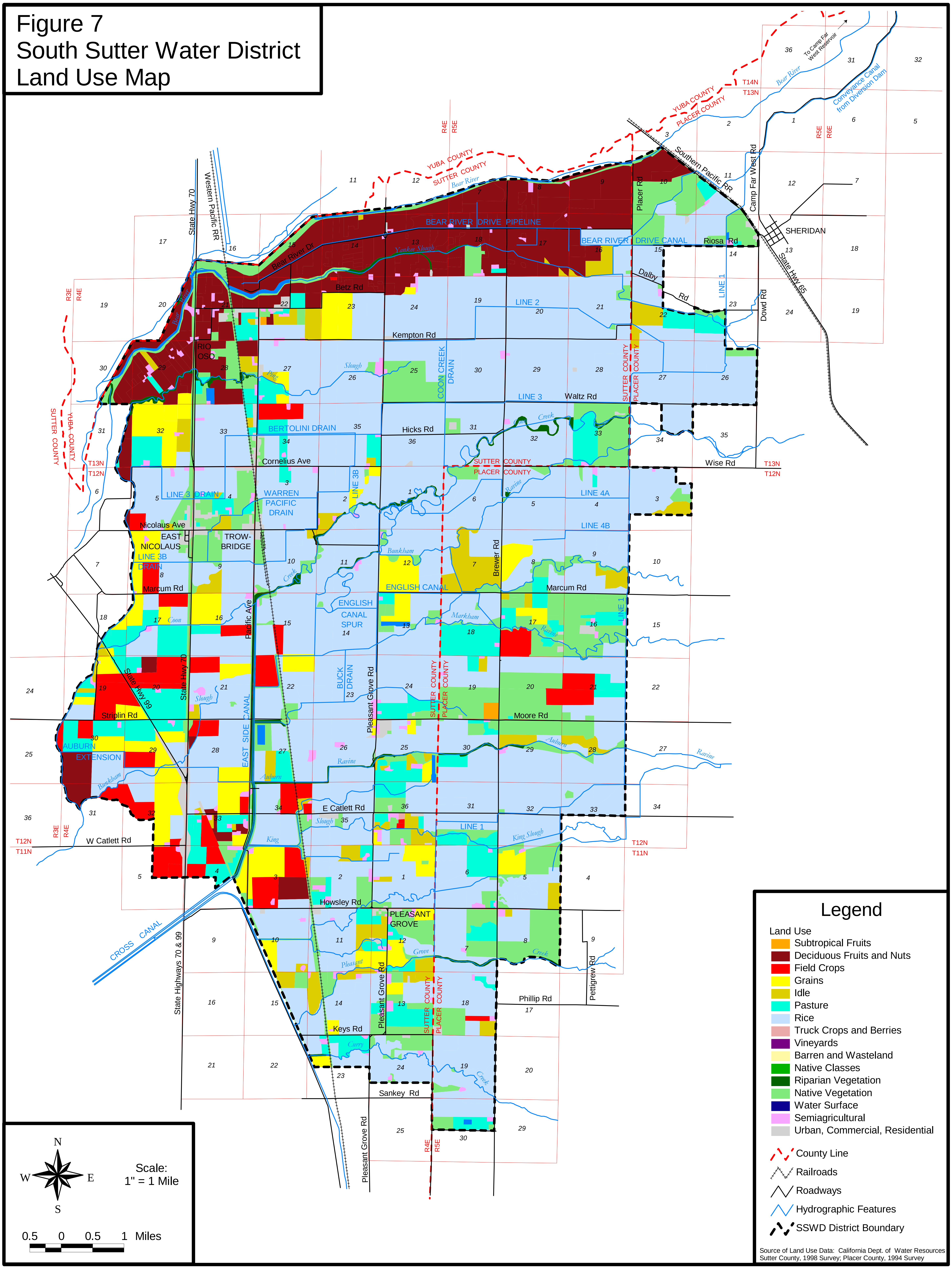

CAMP FAR WEST DAM & RESERVOIR
POINT OF DIVERSION
DIVERSION DAM
CONVEYANCE CANAL
BEAR RIVER
BEAR RIVER DRIVE PUMPING STATION
BEAR RIVER DRIVE CANAL
BEAR RIVER DRIVE PIPELINE
LINE 1
YANKEE SLOUGH HEADGATE
DISTRICT BOUNDARY
PLACE OF USE
GROSS AREA = 57,263 ACRES
LINE 2
COON CREEK HEADGATE
LINE 8
COON CREEK DRAIN
BERTOLINI DRAIN
LINE 3B
LINE 3 DRAIN
WARREN PACIFIC DRAIN
LINE 4A
LINE 4B
LINE 3B DRAIN
ENGLISH CANAL
ENGLISH CANAL SPUR
MARKHAM HEADGATE
LINE 7
EAST SIDE CANAL
BUCK DRAIN
AUBURN HEADGATE
AUBURN EXTENSION
COPPIN DAM
KING SLOUGH HEADGATE
COON CREEK ENTERS NATOMAS CROSS CANAL APPROXIMATELY 1 MILE EAST OF VERONA
DROP INTO PLEASANT GROVE CANAL
FEATHER RIVER
CROSS CANAL
SCALE
1inch = 4000 feet
1:48000
SURFACE WATER INTAKE TO SSWD SYSTEM
CONSTRUCTED DITCH USED FOR IRRIG. WATER
DRY NATURAL STREAM CHANNEL USED FOR IRRIG.
RE-CONSTRUCTED STREAM CHANNEL USED FOR IRRIG.
PIPELINE
OPERATIONAL SPILL FROM SSWD SYSTEM
FLOW
South Sutter Water District
Sutter and Placer Counties - California
INLAND SURFACE WATERS PLAN
IRRIGATION SYSTEM
JUNE 1992
MURRAY, BURNS AND KIENLEN
A CORPORATION
CONSULTING CIVIL ENGINEERS
MAP NO.
SSWD-2

FIGURE 6

Figure 7
South Sutter Water District
Land Use Map



APPENDIX 1

TO

SOUTH SUTTER WATER DISTRICT

WATER MANAGEMENT PLAN

Excerpts from NRCS Soils Survey

Erosion can be controlled by using permanent cover in orchards. Cultivation to establish permanent cover should be across the slope. Orchards should be planted and worked across the slope. To avoid compaction, this soil should not be worked when wet. Cobbles and slope make cultivation difficult. Sprinklers should be used in irrigating.

In pear orchards, a permanent cover crop can be annual grasses and weeds, which are mowed. A perennial permanent sod cover is low growing legumes and perennial grasses, such as white Dutch clover, Salina strawberry clover, and Pomar orchardgrass. It should be mowed in spring and summer through fruit harvest. No legumes should be used in a cover crop in apple orchards.

Irrigated pasture can be a combination of legumes and grasses planted in a well prepared seedbed. A typical seed mixture is broadleaf trefoil and Akaroa orchardgrass. The legume seed is inoculated before planting. The pasture should be mowed to prevent clumping.

All crops respond to applications of nitrogen and phosphorus. Potassium is usually adequate. Apples and pears may need small applications of zinc, magnesium, and boron. In orchards under permanent cover, fertilizer rates are generally increased by about 50 percent.

On pasture and in apple and pear orchards, irrigation water is applied by sprinklers at a rate of 0.25 to 0.35 inch per hour. A total of 3.5 to 5.5 inches of water is applied at each irrigation. The frequency of irrigation is every 10 to 14 days during July and August. Approximately 3 1/2 acre-feet of water is used annually.

This Aiken soil is one of the best soils in the area for ponderosa pine production. It is suited to highly intensive management. The cobbles do not restrict tree growth. This soil is capable of producing about 152 cubic feet, or 947 board feet (International rule), per acre annually or merchantable timber from a fully stocked, even-aged stand of 70 years. Conventional methods can be used in tree harvest, but their use may be restricted in winter. Roads and skid trails should be protected from runoff. Grades on unsurfaced roads should be less than 12 percent. Reforestation after harvest must be managed to reduce competition from undesirable understory plants. Christmas trees are well suited to this soil. Intensive pruning is needed to reduce excessive growth between whorls.

Orchard and pasture areas have good potential as habitat for California quail, mourning dove, and band-tailed pigeon. Forested areas provide habitat for black-tailed deer, black bear, gray squirrel, and wild turkey. To encourage wildlife populations, shrub hedgerows can be established along fence lines, roadsides, and streambanks to provide needed cover and nesting areas. Deer present serious depredation problems in orchards and vineyards.

The construction of vacation homes is increasing on this Aiken soil. The major limitations to urban use are the moderately slow permeability of the subsoil, the shrink-swell potential of the subsoil, the slope, and the limited ability to support a load. Dwelling and road construction can be designed to offset the shrink-swell potential and the limited ability to support a load. In locating roads, special care is needed to minimize the heights of cuts and fills. Cuts and fills greater than 6 feet make access to building sites a problem. Septic tank absorption fields may not function properly because of the slope and the moderately slow permeability.

Capability unit IVe-7(22) irrigated and nonirrigated; Storie index 37.

104—Alamo-Fiddyment complex, 0 to 5 percent slopes. These nearly level to undulating soils are on low terraces at elevations of 50 to 130 feet. The unit is about 50 percent Alamo soil and 30 percent Fiddyment soil. The Alamo soil is in nearly level basins and drainageways, and the Fiddyment soil is on side slopes and ridges. The average annual precipitation is about 20 inches. The average annual air temperature is about 62 degrees F. The average frost-free season is about 270 days. Natural vegetation is annual grasses, forbs, and weeds.

About 10 percent of this unit is included areas of San Joaquin sandy loam, 5 percent Cometa sandy loam, and 5 percent Kaseberg loam.

The Alamo soil is a poorly drained clay that is moderately deep over a hardpan. It has slopes of 0 to 2 percent. It formed in fine textured alluvium from mixed sources.

Typically, the surface layer is dark gray mottled clay about 9 inches thick. The underlying material is dark gray and dark grayish brown, neutral and mildly alkaline clay. At a depth of about 37 inches is a hardpan.

Permeability is very slow. The available water capacity is 2.5 to 6.0 inches. The effective rooting depth is 20 to 40 inches. The water table is near the surface from winter to early in spring. Surface runoff is slow or ponded. The hazard of erosion is slight.

The Fiddyment soil is well drained and is moderately deep over a hardpan. It formed in old valley fill indurated siltstone or sandstone.

Typically, the surface layer is light yellowish brown loam and silt loam about 12 inches thick. The subsoil is brown and yellowish brown dense clay loam. At a depth of 28 inches is a hardpan. At 35 inches is hard sandstone. In a few places, the surface layer is fine sandy loam.

Permeability is very slow. The available water capacity is 2.0 to 3.5 inches. The effective rooting depth is 20 to 37 inches. The dense subsoil restricts roots, reducing the available water to plants. Surface runoff is slow. The erosion hazard is slight. The soil is saturated for short periods following intense rainstorms.

Most areas of this unit are used for dryland winter grains, irrigated pasture, and rice.

To avoid compaction, these soils should not be cultivated or equipment moved across them when wet, except in growing rice. Flood, border, or sprinkler irrigation is suitable.

When grain is grown, these soils are usually fallowed in alternate years to conserve moisture and control weeds. The low yields can be improved with applications of nitrogen, especially when it is applied in both nitrate and ammonia form. Yields are sometimes reduced by water ponding on the Alamo soil.

Irrigated pasture can be a combination of legumes and grasses planted in a well prepared seedbed. A typical seed mixture is narrowleaf trefoil and Goars tall fescue. The legume seed is inoculated before planting. The pasture should be mowed to prevent clumping. The pasture responds to applications of nitrogen and phosphorus. Leveling for border irrigation may expose a hardpan. The frequency of irrigation is about every 5 to 8 days during July and August. Approximately 4 to 4 1/2 acre-feet of water is used annually.

Flatter areas of this unit are well suited to rice production. The soils should be leveled so that water ponds. The hardpan is nearly impervious to the downward movement of the water. Water requirements for rice are about 1 cubic foot per second for 40 acres after the checks are flooded. Rice should be rotated with barley every 2 to 4 years to help control aquatic weeds and soil fungus.

Grainfields have limited potential as habitat for mourning dove. Irrigated pasture and ricefields provide habitat for dove and pheasant. Ricefields provide good habitat for duck. The lack of shrub cover is the major limitation to wildlife habitat. To encourage wildlife populations, shrub hedgerows can be established along fence lines, roadsides, and streambanks to provide needed cover and nesting areas.

This unit supports little construction except for farmsteads. The major limitations to construction on the Alamo soil are wetness, the very slow permeability of the subsoil, the shrink-swell potential, and the limited ability to support a load. The major limitations to construction on the Fiddyment soil are the very slow permeability of the subsoil, the shallow depth to hardpan, and the limited ability of the soil to support a load. Farmsteads should be on the Fiddyment soil to avoid the problems of wetness and shrink swell. Septic tank absorption fields may not function properly because of wetness, the very slow permeability, and a hardpan within 40 inches of the surface.

Capability unit IVw-5(17) irrigated and nonirrigated; Storie index 22.

105—Alamo Variant clay, 2 to 15 percent slopes. This is a moderately deep, gently sloping, somewhat poorly drained clay on alluvial bottoms and rolling foot slopes in valleys between volcanic ridges. It formed over alluvium from mixed sources and colluvium and residuum from volcanic mudstone and andesite. Elevations are 100 to 200 feet. The average annual precipitation ranges from 20 to 25 inches. The average annual air temperature is about 61 degrees F. The average frost-free season is about 250 days. Natural vegetation is annual grasses and forbs.

About 10 percent of the acreage is included areas of a clay 10 to 20 inches deep over volcanic mudstone. On about 20 percent of the acreage, the surface of the Alamo variant is about 10 percent chert and andesite cobbles.

Typically, the surface layer of the Alamo variant is black and very dark gray clay about 25 inches thick. The underlying material is variegated very dark grayish brown and grayish brown, calcareous sandy clay. At a depth of about 36 inches is weathered volcanic mudstone.

Permeability is very slow. The available water capacity is 4.5 to 9.5 inches. The effective rooting depth is 36 to 60 inches. The water table rises to within 10 to 30 inches of the surface during the winter and early in spring. Surface runoff is slow to medium. The hazard of erosion is slight to moderate.

This soil is used mainly for annual rangeland. A few areas are being subdivided for homesites.

This soil has good potential for rangeland. Forage can be increased by the introduction of improved annuals, such as Blando bromegrass and Lana vetch, and improved perennial dryland grasses, such as Perlagrass. They should be planted in a well prepared seedbed. In a favorable year, the green feed period is from March 15 to June 15. Grazing should be controlled so that desirable vegetation, such as soft chess, wild oats, and filaree, is maintained and enough vegetation is left to protect the soil from depletion and erosion. Range plants should be grazed only when the soil is dry. They respond to applications of nitrogen, phosphorus, and sulfur.

This soil has good potential as habitat for quail and mourning dove. The lack of shrub cover is the most limiting factor for good wildlife habitat. To encourage wildlife populations, shrub hedgerows can be established along fence lines, roadsides, and streambanks to provide needed cover and nesting areas.

The major limitations to urban use are wetness, the very slow permeability of the subsoil, the shrink-swell potential, and the limited ability of the soil to support a load. Dwelling and road construction can be designed to offset these limitations. Septic tank absorption fields may not function properly because of the wetness and the very slow permeability of the subsoil. Community sewage systems should be anticipated for medium and high density subdivisions.

Capability unit IIIe-5(17) nonirrigated; Storie index 31.

106—Andregg coarse sandy loam, 2 to 9 percent slopes. This is a moderately deep, gently rolling, well drained soil underlain by weathered granitic bedrock. It formed in residuum on low hills in the Loomis Basin.

urban use are the slope, the shrink-swell potential of the subsoil, and the limited ability of the soil to support a load. Dwelling and road construction can be designed to offset the shrink-swell potential and the limited ability to support a load. In locating roads, special care is needed to minimize the heights of cuts and fills. Cuts and fills greater than 6 feet make access to building sites a problem. Septic tank absorption fields may not function properly because of the slope.

Capability unit IVe-7(22) irrigated and nonirrigated; Storie index 42.

139—Cohasset cobbly loam, 30 to 50 percent slopes. This is a deep, steep, well drained cobbly soil underlain by weathered andesitic conglomerate. It formed in residuum on side slopes of volcanic ridges at elevations of 2,000 to 4,600 feet. The average annual preciptiation, some of which falls as snow, ranges from 40 to 60 inches. The average annual air temperature is about 55 degrees F. The average frost-free season is between 150 and 200 days. Natural vegetation is conifer-hardwood forest.

About 15 percent of the acreage is included areas of McCarthy cobbly sandy loam and 10 percent is a soil that is similar to this Cohasset soil but is 24 to 40 inches deep to weathered rock.

Typically, the surface layer of this Cohasset soil is dark brown and reddish brown cobbly loam about 18 inches thick. The subsoil is reddish brown cobbly heavy loam and yellowish red and strong brown cobbly clay loam. At a depth of 57 inches is weathered andesitic conglomerate. In a few places, the surface layer is sandy loam.

Permeability is moderate. The available water capacity is 4.5 to 9.5 inches. The effective rooting depth is 40 to 60 inches or more. Surface runoff is rapid. The hazard of erosion is high.

This soil is used mainly for wood crops.

This Cohasset soil is well suited to ponderosa pine production. It is suited to moderate management and is capable of producing about 125 cubic feet, or 700 board feet (International rule), per acre annually of merchantable timber from a fully stocked, even-aged stand of 70 years. The major limitation to timber production is the slope. The cobbles do not appreciably affect the use of this soil. Conventional methods used in tree harvest can be used only with difficulty because of the slope. The slope can also be damaging to the soil resource because of the high erosion hazard. Roads and skid trails should be protected from runoff. Grades on unsurfaced roads should be less than 12 percent. Reforestation after harvest must be managed to reduce competition from undesirable plants. Christmas trees can be grown on this soil. Pruning is needed to reduce the excessive growth between whorls.

Forested areas provide good habitat for black bear, black-tailed deer, band-tailed pigeon, wild turkey, and gray squirrel.

The steepness of slope is the major limitation to be considered in planning home and road construction. Soil slumps can be a hazard to road cuts because of the low strength and the lateral movement of water in winter.

Capability subclass VIe(22) nonirrigated; Storie index 24.

140—Cometa sandy loam, 1 to 5 percent slopes. This is a deep, well drained claypan soil on low terraces at elevations of 75 to 200 feet. It formed in alluvium, mainly from granitic sources. It occurs mainly northwest of Roseville. The average annual precipitation is about 20 inches. The average annual air temperature is about 62 degrees F. The average frost-free season is about 270 days. Natural vegetation is annual grasses, forbs, and scattered oak.

About 10 percent of the acreage is included areas of Fiddyment loam, 5 percent is Kaseberg loam, and 5 percent is San Joaquin sandy loam. The scattered narrow ridges are Ramona sandy loam. Alamo clay is in some drainageways and basins. Also included are a few small areas where slopes range to 9 percent.

Typically, the surface layer of this Cometa soil is brown sandy loam about 18 inches thick. The subsoil is brown clay. At a depth of about 29 inches is compacted very brown sandy loam.

Permeability is very slow. The available water capacity is 4.0 to 6.0 inches. The effective rooting depth is 60 inches or more, but roots are restricted to cracks and faces of peds below a depth of 18 inches because of the dense clay subsoil. Surface runoff is slow. The hazard of erosion is slight. After intense rainstorms, the soil is saturated for a short time.

Most areas are used for dryland winter grains and irrigated pasture. A few areas are in rice.

When grain is grown, this soil is usually fallowed in alternate years to conserve moisture and control weeds. The low yields can be improved by applications of nitrogen, especially when it is applied in both nitrate and ammonia form. To avoid compaction, this soil should not be cultivated or have equipment moved across it when wet, except in growing rice. Suitable irrigation methods are flood, border, or sprinkler.

Irrigated pasture can be a combination of legumes and grasses planted in a well prepared seedbed. A typical seed mixture is narrowleaf trefoil and Akaroa orchardgrass. The legume seed is inoculated before planting. The pasture should be mowed to prevent clumping. It responds to applications of nitrogen and phosphorus. Leveling for border irrigation may expose the dense clay subsoil. The frequency of irrigation is about every 5 to 8 days during July and August. Approximately 4 to 4 1/2 acre-feet of water is used annually.

Flatter areas are well suited to rice. The soil needs to be leveled so that water can be ponded on it. The clay subsoil and the compacted substratum are nearly impervious to the downward movement of water. Water requirements for rice are about 1 cubic foot per second for 40 acres after the checks are flooded. Rice should be rotated with barley every 2 to 4 years to help control aquatic weeds and soil fungus.

Grainfields have limited potential as habitat for mourning dove. Irrigated pasture and ricefields provide habitat for dove and pheasant. Ricefields provide good habitat for duck. The lack of shrub cover is the major limitation to wildlife habitat. To encourage wildlife populations, shrub hedgerows can be established along fence lines, roadsides, and streambanks to provide needed cover and nesting areas.

This soil supports little construction except for farmsteads. The major limitations to construction are the very slow permeability of the subsoil, the shrink-swell potential of the soil, and the limited ability of the soil to support a load. Dwelling and road construction can be designed to offset most of these limitations. Septic tank absorption fields may not function properly during periods of rain or heavy use because of the very slow permeability in the subsoil and the substratum.

Capability unit IIIe-3(17) irrigated and nonirrigated; Storie index 39.

141—Cometa-Fiddyment complex, 1 to 5 percent slopes. These undulating soils are on low terraces generally west of State Route 65 and south of Auburn Ravine. They occur at elevations of 75 to 200 feet. The unit is about 35 percent Cometa soil and 35 percent Fiddyment soil. The Cometa soil is on the younger land surfaces, and the Fiddyment on the older surfaces. In some areas the Cometa soil is in the higher positions and in other areas in the lower positions, depending on the geologic deposition and erosion cycle. In general, the surface of the Cometa soil has a brown cast and that of the Fiddyment has a yellower or grayer cast. The average annual precipitation is about 20 inches. The average annual air temperature is about 62 degrees F. The average frost-free season is about 270 days. Natural vegetation is annual grasses and forbs.

About 10 percent of this unit is included areas of San Joaquin sandy loam, 10 percent is Kaseberg loam, 5 percent is Ramona sandy loam on scattered narrow ridges, and 5 percent is Alamo clay in some drainageways and basins.

The Cometa is a deep, well drained claypan soil that formed in alluvium, mainly from granitic sources.

Typically, the surface layer is brown sandy loam about 18 inches thick. The subsoil is brown clay. At a depth of about 29 inches is compacted very pale brown sandy loam.

Permeability is very slow. The available water capacity is 4.0 to 6.0 inches. The effective rooting depth is 60 inches or more, but roots are restricted to cracks and faces of peds below a depth of 18 inches because of the dense clay subsoil. Surface runoff is slow. The hazard of erosion is slight. After intense rainstorms, the soil is saturated for a short time.

The Fiddyment is a well drained soil that is moderately deep over a hardpan. It formed in old valley fill siltstone.

Typically, the surface layer is light yellowish brown loam and silt loam about 12 inches thick. The subsoil is yellowish brown and brown dense clay loam. At a depth of 28 inches is silica-indurated siltstone.

Permeability is very slow. The available water capacity is 2.0 to 3.5 inches. The effective rooting depth is 20 to 37 inches. The dense subsoil restricts most roots, reducing the water available to plants. Surface runoff is slow. The hazard of erosion is slight. After intense rainstorms, the soil is saturated for a short time.

Most areas are used for winter grain. A few areas are used for irrigated pasture and rice. When grain prices are down, much of the grainland is used for annual rangeland. In the Roseville area, this unit is being subdivided for homesites.

To avoid compaction, these soils should not be cultivated or have equipment moved across them when wet, except in growing rice. Suitable irrigation methods are flood, border, or sprinkler.

After a grain crop these soils are usually fallowed in alternate years to conserve moisture and control weeds. Yields are low but can be improved by applications of nitrogen, especially if it is applied in both nitrate and ammonia form.

Irrigated pasture should consist of a combination of legumes and grasses planted in a well prepared seedbed. A typical seed mixture is narrowleaf trefoil and Akaroa orchardgrass. The legume seed is inoculated before planting. The pasture should be mowed to prevent clumping. It responds to applications of nitrogen and phosphorus. Leveling for broader irrigation may expose hardpan on the Fiddyment soil and dense clay subsoil on the Cometa soil. The frequency of irrigation is about every 5 to 8 days during July and August. Approximately 4 to 4 1/2 acre-feet of water is used annually.

Flatter areas are well suited to rice. The soils need to be leveled so that water can be ponded. The hardpan under the Fiddyment soil and the clay subsoil and compacted substratum of the Cometa soil are nearly impervious to the downward movement of water. Water requirements for rice are about 1 cubic foot per second to 40 acres after the checks are flooded. Rice should be rotated with barley every 2 to 4 years to help control aquatic weeds and soil fungus.

This unit has fair potential for rangeland. Most rangeland is in poor condition because the forage is volunteer grasses, legumes, and forbs. Forage can be increased by introducing improved annuals, such as Blando bromegrass and Lana vetch, and by applying nitrogen, phosphorus, and sulfur. In a favorable year, the green feed period is from about March 15 to June 1. Grazing should be planned so that desirable vegetation, such as soft chess, wild oats, and filaree is maintained and enough vegetation is left to protect the soil from depletion and erosion. Range plants should be grazed only when the soil is dry.

Grainfields and rangeland have limited potential as habitat for mourning dove. Irrigated pasture and ricefields provide habitat for dove and pheasant. Ricefields provide good habitat for duck. The lack of shrub cover is the major limitation to wildlife habitat. To encourage wildlife populations, shrub hedgerows can be established along fence lines, roadsides, and streambanks to provide needed cover and nesting areas.

The major limitations to construction on the Cometa soil are the very slow permeability of the subsoil, the shrink-swell potential of the soil, and the limited ability of the soil to support a load. The major limitations to construction on the Fiddyment soil are the very slow permeability of the subsoil, the moderate depth to hardpan, and the limited ability of the soil to support a load. Dwelling and road construction can be designed to offset the shrink-swell potential and the low bearing strength of the soils. Community sewage systems must be anticipated in medium and high density subdivisions. Septic tank absorption fields may not function properly because of the very slow permeability of the subsoil and substratum and the hardpan under the Fiddyment soil.

Capability unit IVe-3(17) irrigated and nonirrigated; Storie index 34.

142—Cometa-Ramona sandy loams, 1 to 5 percent slopes. These undulating soils are on low terraces in the Roseville area and west of Lincoln. They occur at elevations of 75 to 200 feet. The unit is about 50 percent Cometa soil and 30 percent Ramona soil. The Cometa soil is on short side slopes and bottoms, and the Ramona soil is on fingerlike ridges and younger land surfaces. The average annual precipitation is about 20 inches. The average annual air temperature is about 62 degrees F. The average frost-free season is about 270 days. Natural vegetation is annual grasses, forbs, and scattered oak.

About 10 percent of this unit is included areas of San Joaquin sandy loam, 5 percent is Fiddyment loam, and 5 percent is Alamo clay and areas of Xerofluvents in narrow drainageways.

The Cometa is a deep, well drained claypan soil that formed in alluvium, mainly from granitic sources.

Typically, the surface layer is brown sandy loam about 18 inches thick. The subsoil is brown clay. At a depth of about 29 inches is compacted very pale brown sandy loam.

Permeability is very slow. The available water capacity is 4.0 to 6.0 inches. The effective rooting depth is 60 inches or more, but roots are restricted to cracks and faces of peds below a depth of 18 inches because of the dense clay subsoil. Surface runoff is slow. The hazard of erosion is slight. After intense rainstorms, the soil is saturated for a short time.

The Ramona soil is very deep and well drained. It formed in alluvium from predominantly granitic sources.

Typically, the surface layer is brown and light brown sandy loam and loam about 14 inches thick. The subsoil is mixed reddish yellow and yellowish red sandy clay loam about 41 inches thick. The substratum to a depth of 73 inches is reddish yellow gravelly sandy loam.

Permeability is moderately slow. The available water capacity is 6.5 to 9.5 inches. The effective rooting depth is 60 or more inches. Roots extend into the lower granitic alluvium. Surface runoff is medium. The hazard of erosion is slight.

Most areas are used for winter grain. Some are irrigated pasture. Sometimes much of the grainland is used for annual rangeland. In a Roseville area, much of this unit is being subdivided.

To avoid compaction, this unit should not be cultivated or have equipment moved across it when it is wet. Border or sprinkler irrigation is suitable.

After a grain crop these soils are usually fallowed in alternate years to conserve moisture and control weeds. Yields are low to moderate but can be improved by applying nitrogen, especially if it is applied in both nitrate and ammonia form.

Irrigated pasture can be a combination of legumes and grasses planted in a well prepared seedbed. A typical seed mixture is narrowleaf trefoil and Akaroa orchardgrass. The legume seed is inoculated before planting. The pasture should be mowed to prevent clumping. It responds to applications of nitrogen and phosphorus. Leveling for border irrigation may expose the dense clay subsoil of the Cometa soil. The frequency of irrigation is about every 7 to 10 days during July and August. Approximately 4 to 4 1/2 acre-feet of water is used annually.

This unit has fair potential for rangeland. Most rangeland is in poor condition because the forage is volunteer grasses, legumes, and forbs. Forage production can be increased by introducing improved annuals, such as Blando bromegrass and Lana vetch, and by applying nitrogen, phosphorus, and sulfur. In a favorable year, the green feed period is from about March 15 to June 1. Grazing should be planned so that desirable vegetation, such as soft chess, wild oats, and filaree, is maintained and enough vegetation is left to protect the soil from depletion and erosion. Range plants should be grazed only when the soil is dry.

Grainfields and rangeland have limited potential as habitat for mourning dove. Irrigated pasture provides habitat for dove and pheasant. The lack of shrub cover is the major limitation to wildlife habitat. To encourage wildlife populations, shrub hedgerows can be established along fence lines, roadsides, and streambanks to provide needed cover and nesting areas.

The major limitations to urban use of the Cometa soil are the very slow permeability of the subsoil, the shrink-swell potential of the subsoil, and the limited ability of the soil to support a load. The major limitation to urban use of the Ramona soil is the moderately slow permeability of the subsoil. Dwelling and road construction can be designed to offset the shrink-swell potential and the low bearing strength of the Cometa soil. Community sewage systems must be anticipated in medium and high density subdivisions. Septic tank absorption fields may not function properly because of the very slow permeability of the subsoil in the Cometa soil.

Capability unit IIIe-3(17) irrigated and nonirrigated; Storie index 50.

143—Dubakella very stony loam, 9 to 50 percent slopes. This is a moderately deep, well drained very stony soil underlain by ultrabasic rock. It formed in residuum in small, scattered areas of serpentinitic uplands in the eastern part of the survey area. Elevations are 1,000 to 4,000 feet. The average annual precipitation, some of which falls as snow, ranges from 40 to 60 inches. The average annual air temperature is about 57 degrees F. The average frost-free season is between 150 and 250 days. Natural vegetation is brush, stunted conifer, and annual grasses.

About 20 percent of the acreage is included areas of a soil that is similar to this Dubakella soil but is only 10 to 20 inches deep to hard serpentine bedrock, 5 percent is Mariposa gravelly loam, and 10 percent is rock outcrop.

Typically, the surface layer of this Dubakella soil is reddish brown very stony loam and very cobbly loam about 17 inches thick. The subsoil is brown cobbly clay. At a depth of about 31 inches is weathered serpentinized rock.

Permeability is slow. The available water capacity is 2.0 to 4.0 inches. The effective rooting depth is 21 to 33 inches. Fertility is very low because of a calcium to magnesium imbalance. Surface runoff is medium to rapid. The hazard of erosion is moderate to high.

This soil is used mainly for watershed. Some areas are used for wood crops.

This soil is not well suited to ponderosa pine production. It is capable of producing about 44 cubic feet, or 87 board feet (International rule), per acre annually of merchantable timber from a fully stocked, even-aged stand of 70 years. The major limitation to production is a calcium to magnesium imbalance that causes a very low level of fertility. There is some problem with windthrow because of the clay subsoil. Timber should not be harvested unless harvest is beneficial to the appearance of the stand or the soil is part of a block that contains better timber soils. Reforestation after harvest must be managed to reduce competition from brush.

Brushy areas provide good cover habitat for black-tailed deer and black bear.

Steepness of slope, depth to rock, and a slowly permeable clay subsoil are the major limitations to be considered in planning cabin and road construction. Soil slumps can be a hazard to road cuts because of the low strength and the lateral movement of water in winter. Septic tank absorption fields are marginal because of the slowly permeable subsoil and the depth to hard serpentine rock.

Capability subclass VIIs(22) nonirrigated; Storie index 13.

144—Exchequer very stony loam, 2 to 15 percent slopes. This is a shallow, somewhat excessively drained very stony soil underlain by hard andesitic breccia. It formed in residuum on long, broad volcanic ridges at elevations of 100 to 2,000 feet. The average annual precipitation ranges from 20 to 35 inches. The average annual air temperature is about 61 degrees F. The average frost-free season is between 230 and 270 days. Natural vegetation is annual grasses, forbs, and scattered blue and live oak.

About 15 percent of the acreage is included areas of Inks cobbly loam, 5 percent is a soil that is similar to the Inks soil but has a reddish brown loam subsoil, 5 percent is a shallow soil that has a brown clay subsoil, and 2 percent is areas of exposed andesitic breccia (lava cap) 10 to 50 square feet in size. Small areas of this Exchequer soil are strongly acid.

Typically, the soil is brown very stony loam and cobbly loam. At a depth of about 11 inches is hard andesitic breccia.

Permeability is moderate. The available water capacity is 0.5 to 2.5 inches. The effective rooting depth is 8 to 20 inches. Surface runoff is medium. The hazard of erosion is slight to moderate. After intense rainstorms, this soil is saturated and water flows across the surface for a short time.

Most areas are used for annual rangeland.

The major limitation to rangeland is the shallowness over rock. The grass is dry 1 to 2 weeks after the last spring rain. In a favorable year, the green feed period is from about March 15 to May 15. Grazing should be planned so that desirable vegetation, such as soft chess, wild oats, and filaree, is maintained and enough vegetation is left to protect the soil from depletion and erosion. Range plants should be grazed only when the soil is dry.

This soil has some potential as habitat for California quail and mourning dove.

Stones and the depth to hard rock are the major limitations to be considered in planning road construction. Septic tank absorption fields may not function properly because the depth to hard rock is less than 20 inches.

Capability subclass VIIs(18) nonirrigated; Storie index 15.

145—Exchequer-Rock outcrop complex, 2 to 30 percent slopes. This map unit is on long, broad volcanic ridges and their side slopes. It is about 60 percent Exchequer soil and 15 percent andesitic breccia (lava cap). Elevations are 100 to 1,000 feet. The average annual precipitation ranges from 20 to 35 inches. The average annual air temperature is about 61 degrees F. The average frost-free season is between 230 and 270 days. Natural vegetation is annual grasses, forbs, and scattered blue and live oak.

About 10 percent of this unit is included areas of Inks cobbly loam, 5 percent is a soil that is similar to the Inks soil but has a reddish brown loam subsoil, and 5 percent is a shallow soil that has a brown clay subsoil. A few areas of this Exchequer soil are strongly acid.

The Exchequer is a shallow, somewhat excessively drained very stony soil that formed in residuum from hard andesitic breccia.

Typically, the soil is brown very stony loam and cobbly loam. At a depth of about 11 inches is hard andesitic breccia.

Permeability is moderate. The available water capacity is 0.5 to 2.5 inches. The effective rooting depth is 8 to 20 inches. Surface runoff is medium to rapid. The hazard of erosion is slight to high. After intense rainstorms, this soil is saturated and water flows across the surface for a short time.

Rock outcrop consists of areas of hard andesitic breccia 50 to 500 square feet.

Surface runoff is very rapid. There is no hazard of erosion.

Most areas are used for annual rangeland.

The major limitations to rangeland are the outcrops of rock and the shallow soil. The grass is dry 1 to 2 weeks after the last spring rain. The outcrop is essentially barren. In a favorable year, the green feed period is from about March 15 to May 15. Grazing should be planned so that desirable vegetation, such as soft chess, wild oats, and filaree, is maintained and enough vegetation is left to protect the soil from depletion and erosion. Range plants should be grazed only when the soil is dry.

This unit has some potential as habitat for California quail and mourning dove.

Steepness of slope, the rock outcrop, and the shallowness over hard rock are the major limitations to be considered in planning road construction. Septic tank absorption fields should not be planned on this unit because the soil material is not deep enough to install leach fields.

Capability subclass VIIs(18) nonirrigated; Storie index 12.

146—Fiddyment loam, 1 to 8 percent slopes. This is a moderately deep, well drained soil on low terraces of siltstone at elevations of 75 to 135 feet. The average annual precipitation is about 20 inches. The average annual temperature is about 62 degrees F. The average frost-free season is about 270 days. Natural vegetation is annual grasses and forbs.

About 15 percent of this acreage is included areas of Kaseberg loam, 5 percent is Cometa sandy loam, and 5 percent is San Joaquin sandy loam. Alamo clay occurs in some drainageways and basins. East and west of Roseville, adjacent to the Sacramento County line, is about 600 acres of a soil that is similar to this Fiddyment soil but has a brown loam subsoil. On some ridges north of Pleasant Grove Creek and east of Brewer Road, the surface layer contains some chert gravel, possibly remnants of an older surface.

Typically, the surface layer of this Fiddyment soil is light yellowish brown loam and silt loam about 12 inches thick. The subsoil is brown and yellowish brown dense clay loam. At a depth of 28 inches is silica-indurated siltstone.

Permeability is very slow. The available water capacity is 2.0 to 3.5 inches. The effective rooting depth is 20 to 37 inches. The dense subsoil restricts most roots, reducing the water available to plants. Surface runoff is slow to medium. The hazard of erosion is slight to moderate. After intense rainstorms, the soil is saturated for a short time.

Most areas are used for winter grain. Sometimes much of the grainland is used for annual range. A few areas are used for irrigated pasture and forbs.

Erosion can be controlled by cultivating across the slope, especially where slopes are greater than 5 percent. To avoid compaction, this soil should not be cultivated or have equipment moved across it when wet, except in growing rice. Flood, border, or sprinkler irrigation is suitable.

After a grain crop, this soil is usually fallowed in alternate years to conserve moisture and control weeds. Yields are low but can be improved by applying nitrogen, especially if it is applied in both nitrate and ammonia form.

Irrigated pasture can be a combination of legumes and grasses planted in a well prepared seedbed. A typical seed mixture is narrowleaf trefoil and Akaroa orchardgrass. The legume seed is inoculated before planting. The pasture should be mowed to prevent clumping. It responds to applications of nitrogen and phosphorus. Leveling for border irrigation may expose areas of the dense subsoil or the hardpan. The frequency of irrigation is about every 5 to 8 days during July and August. Approximately 4 to 4 1/2 acre-feet of water is used annually.

Flatter areas are well suited to rice. The soil needs to be leveled so that water can be ponded. The dense subsoil and the hardpan are nearly impervious to the downward movement of water. Water requirements for rice are about 1 cubic foot per second for 40 acres after the checks are flooded. Rice should be rotated with barley every 2 to 4 years to help control aquatic weeds and soil fungus.

This soil has fair potential for rangeland. Most rangeland is in poor condition because the forage is volunteer grasses, legumes, and forbs. Forage production can be increased by introducing improved annuals, such as Blando bromegrass and Lana vetch, and by applying nitrogen, phosphorus, and sulfur. In a favorable year, the green feed period is from about March 15 to June 1. Grazing should be planned so that desirable vegetation, such as soft chess, wild oats, and filaree, is maintained and enough vegetation is left to protect the soil from depletion and erosion. Range plants should be grazed only when the soil is dry.

Grainfields and rangeland have limited potential as habitat for mourning dove. Irrigated pasture and ricefields provide habitat for dove and pheasant. Ricefields provide good habitat for duck. The lack of shrub cover is the major limitation to wildlife habitat. To encourage wildlife populations, shrub hedgerows can be established along fence lines, roadsides, and streambanks to provide needed cover and nesting areas.

There is some use of this soil as rural subdivisions. The major limitations to urban use are the very slow permeability of the subsoil, the moderate depth to the hardpan, and the limited ability of the soil to support a load. Dwellings can be designed to offset the low bearing strength and the moderate depth to the hardpan. Septic tank absorption fields may not function properly because of the very slowly permeable subsoil and the shallowness over the hardpan.

Capability unit IVe-3(17) irrigated and nonirrigated; Storie index 27.

147—Fiddyment-Kaseberg loams, 2 to 9 percent slopes. These undulating to gently rolling soils are on low siltstone terraces at elevations of 75 to 135 feet. The unit is about 50 percent Fiddyment soil and 30 percent Kaseberg soil. The Fiddyment soil is moderately deep over a hardpan, and the Kaseberg soil is shallow over a hardpan. The average annual precipitation is about 20 inches. The average annual air temperature is about 62 degrees F. The average frost-free season is about 270 days. Natural vegetation is annual grasses and forbs.

About 10 percent of this unit is included areas of Alamo clay in some swales and drainageways. North of Pleasant Grove Creek and east of Brewer Road, some ridges are covered with chert gravel, which is a remnant of an older surface. In the upper reaches of Pleasant Grove Creek, the soil profile in about 500 acres of this unit is 10 to 20 percent gravel and cobbles.

The Fiddyment is a well drained soil that is moderately deep over a hardpan. It formed in old valley fill siltstone.

Typically, the surface layer is light yellowish brown loam and silt loam about 12 inches thick. The subsoil is brown and yellowish brown dense clay loam. At a depth of 28 inches is silica-indurated siltstone.

Permeability is very slow. The available water capacity is 2.0 to 3.5 inches. The effective rooting depth is 20 to 37 inches. The dense subsoil restricts most roots, reducing the water available to plants. Surface runoff is slow to medium. The hazard of erosion is slight to moderate. After intense rainstorms, the soil is saturated for a short time.

The Kaseberg is a well drained soil that is shallow over a hardpan. It formed in old valley fill siltstone.

Typically, the surface layer is light brownish gray loam with yellowish brown mottles and is about 6 inches thick. The subsoil is pale brown loam about 8 inches thick. The underlying material is light gray silt loam. At about 16 inches is a silica-indurated hardpan 1 inch thick. It is underlain by siltstone.

Permeability is moderate. The available water capacity is 1.5 to 3.5 inches. The effective rooting depth is 10 to 20 inches. Surface runoff is slow to medium. The hazard of erosion is slight to moderate. After intense rainstorms, the soil is saturated for a short time.

Most areas are used for winter grain. Sometimes much of the grainland is used for annual range.

Erosion can be controlled by cultivating across the slope, especially where slopes are greater than 5 percent. To avoid compaction, this unit should not be cultivated or have equipment moved across it when wet.

After a grain crop, this unit is usually fallowed in alternate years to conserve moisture and control weeds. Yields are low, but can be improved by applying nitrogen, especially if it is applied in both nitrate and ammonia form.

This unit has fair potential for rangeland. Most rangeland is in poor condition because the forage is volunteer grasses, legumes, and forbs. Forage production can be increased by introducing improved annuals, such as Blando bromegrass and Lana vetch, and by applying nitrogen, phosphorus, and sulfur. In a favorable year, the green feed period is from about March 15 to May 15. Grazing should be planned so that desirable vegetation, such as soft chess, wild oats, and filaree, is maintained and enough vegetation is left to protect the soil from depletion and erosion. Range plants should be grazed only when the soil is dry.

Grain fields and rangeland have limited potential as habitat for mourning dove. The lack of shrub cover is the major limitation to wildlife habitat. To encourage wildlife populations, shrub hedgerows can be established along fence lines, roadsides, and streambanks to provide needed cover and nesting areas.

This unit supports little construction except for farmsteads. The major limitations to urban use of the Fiddyment soil are the very slow permeability of the subsoil, the moderate depth to the hardpan and siltstone, and the limited ability of the soil to support a load. The Kaseberg soil is limited by the shallowness over the hardpan and siltstone. Septic tank absorption fields may not function properly because the depth to the hardpan and the underlying siltstone ranges from 10 to 37 inches.

Capability unit IVe-3(18) nonirrigated; Storie index 24.

148—Henneke-Rock outcrop complex, 5 to 50 percent slopes. These rolling to steep soils are on serpentine foothills in discontinuous belts at elevations of 1,200 to 1,700 feet. The unit is about 60 percent Henneke soil and 20 percent serpentine Rock outcrop. The average annual precipitation ranges from 30 to 40 inches. The average annual air temperature is about 60 degrees F. The average frost-free season is between 230 and 270 days. Natural vegetation is annual grasses, forbs, chamise, and scattered Digger pine.

About 10 percent of this unit is included areas of a soil that is similar to this Henneke soil but has a loam and clay loam subsoil, and 10 percent is a soil that is also similar to this Henneke soil but its subsoil is less than 35 percent rock fragments.

The Henneke is a shallow, well drained soil that formed in residuum from hard serpentine rock.

Typically, the surface layer is reddish brown gravelly loam about 3 inches thick. The subsoil is yellowish red very gravelly clay loam and reddish brown very gravelly clay. At a depth of about 18 inches is serpentine rock.

Permeability is moderately slow. The available water capacity is 0.5 to 2.0 inches. The effective rooting depth is 10 to 20 inches. Fertility is very low because of a calcium to magnesium imbalance. Surface runoff is medium to rapid. The hazard of erosion is high.

Rock outcrop consists of areas of hard serpentine rock ranging up to 2 acres.

Surface runoff is very rapid. There is no hazard of erosion.

This unit is better suited to watershed than to other uses because of the very low fertility, the rock outcrop, and the slope.

Brushy areas provide some cover for wildlife.

The rock outcrop, slope, very low fertility, and shallowness over hard rock are the major limitations to development of this unit. Septic tank absorption fields may not function properly because the depth to hard rock is less than 20 inches.

Capability subclass VIIIs(18) nonirrigated; Storie index 9.

149—Horseshoe gravelly loam, 2 to 9 percent slopes. This is a very deep, well drained gravelly soil on tertiary river terraces. It formed in alluvium from mixed sources. The alluvium is high in content of gravel and cobble sized quartz, chert, and other resistant minerals and rocks. Elevations are 3,000 to 4,000 feet. The average annual precipitation, some of which falls as snow, ranges from 50 to 60 inches. The average annual air temperature is about 57 degrees F. The average frost-free season is between 170 and 225 days. Natural vegetation is conifer-hardwood forest.

About 5 percent of the acreage is included areas of Aiken loam, 5 percent is Cohasset loam, and 10 percent is tailing areas, a result of hydraulic mining.

Typically, the surface layer of this Horseshoe soil is mixed dark grayish brown and brown gravelly loam about 18 inches thick. The subsoil is yellowish red and red gravelly heavy loam and gravelly clay loam about 50 inches thick. The underlying material is yellowish red gravelly clay loam. In a few places, the surface layer is loam.

Permeability is moderate. The available water capacity is 6.0 to 9.5 inches. The effective rooting depth is 60 inches or more, but most roots are in the upper 40 inches and tend to mat obliquely in the subsoil. Surface runoff is medium. The hazard of erosion is slight.

Most areas are used for wood crops. A few areas where water is available for irrigation are used for irrigated pasture and for apple orchards. Selected varieties of grapes are also grown. The orchards are planted below elevations of 3,500 feet to help reduce crop losses resulting from freezes late in spring. Some areas provide homesites.

Erosion can be controlled by tilling across the slope and by using cover crops in orchards in winter. Gravel causes minor problems in tilling. To avoid compaction, the soil should not be cultivated or have equipment moved across it when wet. Sprinklers should be used in irrigating.

Wimmera 62 ryegrass and Blando bromegrass provide a satisfactory cover crop in orchards. The annual cover should set seed before it is disked or mowed.

In apple orchards, a permanent cover crop can be annual grasses and weeds, which are mowed. A perennial permanent sod cover should consist of low growing perennial grasses, such as Pomar orchardgrass. It should be mowed in spring and summer through fruit harvest. Legumes are not recommended as a cover crop in apple orchards because excess nitrogen causes poor fruit coloring.

Irrigated pasture can be a combination of legumes and grasses planted in a well prepared seedbed. A typical seed mixture is broadleaf trefoil and Akaroa orchardgrass. The legume seed is inoculated before planting. The pasture should be mowed to prevent clumping.

All crops respond to applications of nitrogen and phosphorus. Potassium is usually adequate. Apples may need small applications of zinc, magnesium, and boron. In orchards under permanent cover, fertilizer rates are generally increased by about 50 percent.

On pasture and in apple orchards, irrigation water is applied by sprinklers at a rate of 0.25 to 0.35 inch per hour. A total of 3.5 to 5.5 inches of water is applied at each irrigation. The frequency of irrigation is every 10 to 14 days during July and August. Approximately 3 1/2 acre-feet of water is used annually.

This Horseshoe soil is one of the best soils in the area for the production of ponderosa pine. It is suited to

This unit is well suited to ponderosa pine production. It is suited to moderate management and is capable of producing about 130 cubic feet, or 776 board feet (International rule), per acre annually of merchantable timber from a fully stocked, even-aged stand of 70 years. The major limitation to timber production is the slope. Rock outcrop does not appreciably affect the use of this unit. Conventional methods used in tree harvest can be used only with difficulty because of the slope. The slope can also be damaging to the soil resource because of the high erosion hazard. Roads and skid trails should be protected from runoff. Grades on unsurfaced roads should be less than 10 percent. Reforestation after harvest must be managed to reduce competition from undesirable plants. Christmas trees can be grown on this unit. Pruning is needed to reduce excessive growth between whorls.

This unit provides good habitat for black bear, black-tailed deer, band-tailed pigeon, wild turkey, and gray squirrel.

Steepness of slope and Rock outcrop are the major limitations to be considered in planning home and road construction. Soil slumps can be a hazard in road cuts because of low strength and the lateral movement of water in winter.

Capability subclass VIs(22) nonirrigated; Storie index 35.

162—Kilaga loam. This is a very deep, nearly level, well drained soil on alluvial bottoms and low terraces. It occurs mainly at elevations of 75 to 150 feet. It formed in alluvium from mixed sources. The average annual precipitation is about 20 inches. The average annual air temperature is about 62 degrees F. The average frost-free season is about 275 days. Natural vegetation is annual grasses, forbs, and scattered valley oak.

About 10 percent of the acreage is included areas of Ramona sandy loam, 10 percent is Cometa sandy loam, 5 percent is San Joaquin sandy loam, and 5 percent is Xerofluvents, occasionally flooded. Also included are some areas where the soil is moderately well drained as a result of nearby irrigation.

Typically, the surface layer is strong brown loam and heavy loam about 19 inches thick. The upper 37 inches of the subsoil is reddish brown clay loam and clay. The lower part to a depth of about 83 inches is reddish brown sandy clay loam.

Permeability is slow. The available water capacity is 8.0 to 10.0 inches. The effective rooting depth is 60 inches or more. Surface runoff is slow. The hazard of erosion is slight.

Most areas are irrigated pasture. Some areas are used for field corn and rice.

To avoid compaction, this soil should not be cultivated or have equipment moved across it when it is wet, except in growing rice. Flood, border, or furrow irrigation is suitable. Corn responds to applications of nitrogen, phosphorus, and potassium.

Irrigated pasture can be a combination of legumes and grasses planted in a well prepared seedbed. A typical seed mixture is narrowleaf trefoil and Akaroa orchardgrass. The legume seed is inoculated before planting. The pasture should be mowed to prevent clumping. It responds to applications of nitrogen and phosphorus. The frequency of irrigation is about every 8 to 14 days during July and August. Approximately 4 to 4 1/2 acre-feet of water is used annually.

This soil is suited to rice. It needs to be leveled so that water can be efficiently ponded. Generally, the water requirements for rice are about 1 cubic foot per second for 40 acres after the checks are flooded. Rice should be rotated with barley every 2 to 4 years to help control aquatic weeds and soil fungus.

Irrigated pasture, cornfields, and ricefields provide habitat for dove and pheasant. Ricefields provide good habitat for duck. The lack of shrub cover is the major limitation to wildlife habitat. To encourage wildlife populations, shrub hedgerows can be established along fence lines, roadsides, and streambanks to provide needed cover and nesting areas.

This soil supports little construction except for farmsteads. The major limitations to construction are the slow permeability of the subsoil and the shrink-swell potential of the soil. Dwelling and road construction can be designed to offset these limitations. Septic tank absorption fields may not function properly during periods of rain or heavy use because of slow permeability in the subsoil.

Capability units IIs-3(17) irrigated, IIIs-3(17) nonirrigated; Storie index 54.

163—Mariposa gravelly loam, 5 to 30 percent slopes. This is a shallow or moderately deep, rolling to hilly, well drained gravelly soil underlain by fractured vertically tilted schist and slate. It formed in residuum, mainly from metasedimentary rock, on uplands at elevations of 1,500 to 3,500 feet. The average annual precipitation, some of which falls as snow, ranges from 35 to 55 inches. The average annual air temperature is about 56 degrees F. The average frost-free season is between 150 and 250 days. Natural vegetation is conifer-hardwood forest and scattered brush and grasses.

About 10 percent of the acreage is included areas of Josephine loam, 5 percent is Sites loam, and 5 percent is Maymen gravelly loam, which occurs on few ridgetops. About 2 percent is scattered rock outcrop.

Typically, the surface layer of this Mariposa soil is brown gravelly loam about 6 inches thick. The subsoil is reddish yellow gravelly silt loam and gravelly clay loam. At a depth of about 28 inches is partially weathered, highly fractured slate.

Permeability is moderate. The available water capacity is 1.5 to 5.0 inches. The effective rooting depth is 15 to

Homesite construction—primarily vacation homes—is increasing on this McCarthy soil. The major limitations to urban use are the slope and the depth to rock. In locating roads, special care is needed to minimize the height of cuts and fills. Cuts and fills greater than 6 feet make access to building sites a problem. Septic tank absorption fields may not function properly because of the slope and the depth to rock.

Capability unit IVe-8(22) irrigated and nonirrigated; Storie index 34.

172—McCarthy cobbly sandy loam, 30 to 50 percent slopes. This is a steep, moderately deep, well drained cobbly soil underlain by weathered andesitic conglomerate. It formed in residuum on side slopes of long, broad volcanic ridges at elevations of 2,000 to 5,300 feet. The average annual precipitation, some of which falls as snow, ranges from 40 to 60 inches. The average annual air temperature is about 55 degrees F. The average frost-free season is between 130 and 225 days. Natural vegetation is conifer-hardwood forest and brush.

About 20 percent of the acreage is included areas of a soil that is similar to this McCarthy soil but is 40 to 60 inches deep to bedrock, 10 percent is Cohasset cobbly loam, and 10 percent is Iron Mountain cobbly sandy loam. Above 4,500 feet on some north slopes is a soil that is similar to this McCarthy soil but has a mean soil temperature of 45 to 47 degrees. Also included are a few areas where slopes range up to 75 percent.

Typically, the surface layer of this McCarthy soil is brown cobbly sandy loam about 13 inches thick. The subsoil is strong brown and reddish yellow very cobbly sandy loam. At a depth of about 39 inches is weathered andesitic conglomerate.

Permeability is moderately rapid. The available water capacity is 1.5 to 3.5 inches. The effective rooting depth is 22 to 40 inches. Surface runoff is rapid. The hazard of erosion is high.

This soil is used mainly for wood crops.

This soil is well suited to ponderosa pine production. It is suited to moderate management and is capable of producing about 105 cubic feet, or 556 board feet (International rule), per acre annually of merchantable timber from a fully stocked, even-aged stand of 70 years. The major limitation to timber production is the slope. Cobbles do not appreciably affect the use of this soil. Conventional methods used in tree harvest can be used only with difficulty because of the slope. The slope can also be damaging to the soil resource because of the high erosion hazard. Roads and skid trails should be protected from runoff. Grades on unsurfaced roads should be less than 12 percent. Reforestation after harvest must be managed to reduce competition from undesirable plants. Christmas trees can be grown on this soil.

This soil provides good habitat for black bear, black-tailed deer, band-tailed pigeon, wild turkey, and gray squirrel.

The steepness of slope and the depth to rock are the major limitations to be considered in planning home and road construction. Soil slumps can be a hazard to road cuts because of the low strength and the lateral movement of water in winter.

Capability subclass VIe(22) nonirrigated; Storie index 18.

173—Pits and dumps. Pits and dumps are sand and gravel pits, refuse dumps, and rock quarries. All are typically barren. All vary in natural drainage, permeability, erosion hazard, runoff, and available water capacity.

Capability subclass VIIIs(17, 18, 22) nonirrigated; Storie index 0.

174—Ramona sandy loam, 0 to 2 percent slopes. This is a very deep, well drained soil on alluvial bottoms and low terraces at elevations of 75 to 150 feet. It formed in alluvium from predominantly granitic sources. The average annual precipitation is about 20 inches. The average annual air temperature is about 62 degrees F. The average frost-free season is about 275 days. Natural vegetation is annual grasses, forbs, and scattered valley oak.

About 10 percent of the acreage is included areas of Kilaga loam, and 5 percent is Cometa sandy loam. Also included are small areas of Xerofluvents, occasionally flooded, and a soil along stream channels that is similar to this Ramona soil but has a darker surface layer.

Typically, the surface layer of this Ramona soil is brown sandy loam and light brown loam about 14 inches thick. The subsoil is mixed reddish yellow and yellowish red sandy clay loam about 41 inches thick. The substratum to a depth of 70 inches or more is reddish yellow gravelly sandy loam.

Permeability is moderately slow. The available water capacity is 6.5 to 9.5 inches. The effective rooting depth is 60 inches or more. Surface runoff is slow. The hazard of erosion is slight.

This soil is used mainly for irrigated field crops, irrigated pasture, and deciduous orchards.

An example of a suitable crop rotation is 4 years of alfalfa or pasture, 1 to 2 years of field corn, and then alfalfa or pasture. Green manure crops should be grown in orchards to maintain an adequate level of organic matter and to improve soil tilth and water penetration. Generally, all crops respond to applications of nitrogen, phosphorus, and potassium. Border, furrow, and sprinkler irrigation are suitable, but the kind of irrigation is generally governed by the crop grown.

This soil has good potential as habitat for mourning dove and pheasant. The lack of shrub cover is the major limitation to wildlife habitat. To encourage wildlife populations, shrub hedgerows can be established along fence lines, roadsides, and streambanks to provide needed cover and nesting areas.

This soil supports little construction except for farmsteads. The major limitation is the moderately slow permeability of the subsoil. Septic tank absorption fields may not function properly during periods of rain or heavy use because of the moderately slow permeability of the subsoil.

Capability class I(17) irrigated; capability unit IIIc-1(17) nonirrigated; Storie index 72.

175—Ramona sandy loam, 2 to 9 percent slopes. This is an undulating, very deep, well drained soil on low terraces at elevations of 100 to 200 feet. It occurs as stringers of higher ground on the terraces. It formed in alluvium from predominantly granitic sources. It is mainly in the Lincoln and Roseville areas. The average annual precipitation is about 20 inches. The average annual air temperature is about 62 degrees F. The average frost-free season is about 275 days. Native vegetation is annual grasses, forbs, and scattered valley oak.

About 10 percent of the acreage is included areas of Cometa sandy loam, 10 percent is Kilaga loam, and 5 percent is San Joaquin sandy loam.

Typically, the surface layer of this Ramona soil is brown sandy loam and light brown loam about 14 inches thick. The subsoil is mixed reddish yellow and yellowish red sandy clay loam about 41 inches thick. The substratum to a depth of 70 inches or more is reddish yellow gravelly sandy loam.

Permeability is moderately slow. The available water capacity is 6.5 to 9.5 inches. The effective rooting depth is 60 inches or more. Surface runoff is slow or medium. The hazard of erosion is slight or moderate.

This soil is used mainly for irrigated pasture, deciduous orchards, and winter grain.

Erosion can be controlled by tilling across the slope and by using cover crops in the orchards in winter. To avoid compaction, this soil should not be cultivated or have equipment moved across it when wet. Sprinklers should be used in irrigating. All crops respond to nitrogen and phosphorus.

Wimmera 62 ryegrass, Blando bromegrass, or Cucamonga bromegrass provide a satisfactory cover crop in orchards. The annual cover should set seed before it is disked or mowed.

Irrigated pasture can be a combination of legumes and grasses planted in a well prepared seedbed. A typical seed mixture is narrowleaf trefoil and Akaroa orchardgrass. The legume seed is inoculated before seeding. The pasture should be mowed to prevent clumping.

On pasture and in deciduous orchards, irrigation water is applied by sprinklers at a rate of 0.25 to 0.35 inch per hour. A total of 3.5 to 5.5 inches of water is applied at each irrigation. The frequency of irrigation is every 10 to 14 days during July and August. Approximately 4 to 4 1/2 acre-feet of water is used annually.

After a grain crop, the soil is usually fallowed in alte nate years to conserve moisture and control weed Yields are low to moderate. They can be improved wit applications of nitrogen, especially when the nitrogen i applied in both nitrate and ammonia form.

Grain fields and orchards have limited potential a habitat for mourning dove. Irrigated pasture provide habitat for dove and pheasant. The lack of shrub cove is the major limitation to wildlife habitat. To encourag wildlife populations, shrub hedgerows can be establishe along fence lines, roadsides, and streambanks to provid needed cover and nesting areas.

There is little construction on this soil except for farm steads. The major limitation is the moderately slow per meability of the subsoil. Septic tank absorption field may not function properly during periods of rain or heav use because of the moderately slow permeability of the subsoil.

Capability units IIe-1(17) irrigated, IIIe-I(17) nonirrigat ed; Storie index 65.

176—Redding and Corning gravelly loams, 2 to 9 percent slopes. These undulating to rolling soils are or high terraces at elevations of 100 to 240 feet. Both soils have a claypan. The Redding soil has a hardpan under the claypan, and the Corning soil has softly consolidated gravelly alluvium under the claypan. A mapped area can consist of only one of these soils or both. The average annual precipitation is about 22 inches. The average annual air temperature is about 62 degrees F. The average frost-free season is about 270 days. Natural vegetation is annual grasses, forbs, and a few scattered oak.

About 5 percent of this unit is included areas of a deep soil that does not have a claypan and supports fair stands of oak trees. Another 5 percent is a soil that is similar to this Redding soil but has a yellowish brown subsoil. Along the contact with the low terraces, there are small areas of Cometa, Fiddyment, and San Joaquin soils.

The Redding is a well drained claypan soil that is moderately deep over a hardpan. It formed in gravelly old valley fill from mixed sources.

Typically, the surface layer is strong brown and yellowish red gravelly loam and reddish brown loam about 14 inches thick. The subsoil is dark reddish brown and reddish brown clay. At a depth of about 28 inches is the hardpan.

Permeability is very slow. The available water capacity is 1.5 to 3.0 inches. The effective rooting depth is 20 to 34 inches. Most roots in the clay subsoil are along the faces of peds, which reduces the water available to plants. Surface runoff is slow or medium. The hazard of erosion is slight or moderate. After intense rainstorms, the soil is saturated for a short time.

The Corning is a well drained, very deep claypan soil that is underlain by gravelly alluvium. It formed in old valley fill from mixed sources.

Typically, the surface layer is reddish brown, yellowish red, and red gravelly loam about 22 iches thick. The subsoil is red and dark red clay about 18 inches thick. The substratum to a depth of 60 inches is strong brown clay loam.

Permeability is very slow. The available water capacity is 4.0 to 6.5 inches. The effective rooting depth is 60 inches or more, but most roots in the clay subsoil are along the faces of peds, which reduces the water available to plants. Surface runoff is slow or medium. The hazard of erosion is slight or moderate. After intense rainstorms, the soil is saturated for a short time.

Most areas are used as annual rangeland. A few areas are used for irrigated pasture and winter grains.

Erosion can be controlled by tilling across the slope. The high content of gravel makes cultivation difficult. To avoid compaction, these soils should not be cultivated or have equipment moved across them when wet. Sprinklers generally should be used in irrigating, but on the flatter slopes, border irrigation can be used.

After a grain crop, these soils are usually fallowed in alternate years to conserve moisture and control weeds. Yields are low but can be improved by applications of nitrogen, especially when the nitrogen is applied in both nitrate and ammonia form.

Irrigated pasture can be a combination of legumes and grasses planted in a well prepared seedbed. A typical seed mixture consists of narrowleaf trefoil and Akaroa orchardgrass. The legume seed is inoculated before planting. The pasture should be mowed to prevent clumping. It responds to applications of nitrogen and phosphorus.

Irrigation water is applied by sprinklers at a rate of 0.25 to 0.35 inch per hour. Leveling for border irrigation may expose the dense clay subsoil. The frequency of irrigation is about every 5 to 8 days during July and August. Approximately 4 to 4 1/2 acre-feet of water is used annually.

This unit has fair potential as rangeland. Most range grasses are low in nutrient content because these soils are low in fertility. Forage production can be increased by introducing improved annuals, such as Blando bromegrass and Lana vetch, and by applying nitrogen, phosphorus, and sulfur. In a favorable year, the green feed period is from about March 15 to June 1. Grazing should be planned so that desirable vegetation, such as soft chess, wild oats, and filaree, is maintained and enough vegetation is left to protect the soil from depletion and erosion. Range plants should be grazed only when the soil is dry.

This unit has limited potential as habitat for mourning dove and California quail. The lack of shrub cover is the major limitation to wildlife habitat. To encourage wildlife populations, shrub hedgerows can be established along fence lines, roadsides, and streambanks to provide needed cover and nesting areas.

In the Sheridan area, some of this unit is being converted to rural subdivisions. The major limitations to urban use of the Redding soil are the very slow permeability of the subsoil and substratum, the moderate depth to a hardpan, and the limited ability of the soil to support a load. The major limitations of the Corning soil are the very slow permeability of the subsoil, the shrink-swell potential of the subsoil, and the limited ability of the soil to support a load. Dwellings and roads can be designed to offset the low bearing strength and the shrink-swell potential. Septic tank absorption fields probably will not function properly on the Redding soil because of the very slow permeability of the subsoil and the underlying hardpan. They will not function on the Corning soil because of the very slow permeability of the subsoil and substratum.

Capability unit IVe-3(17) irrigated and nonirrigated; Storie index Redding 22, Corning 34.

177—Redding and Corning gravelly loams, 9 to 15 percent slopes. These soils occupy prominent mounds and side slopes of high terraces in the Sheridan area. Both soils have a claypan. The Redding soil has a hardpan under the claypan. The Corning soil has gravelly alluvium under the claypan. A mapped area can consist of only one of these soils or both. Elevations are 100 to 240 feet. The average annual precipitation is about 22 inches. The average annual air temperature is about 62 degrees F. The average frost-free season is about 270 days. Natural vegetation is annual grasses, forbs, and a few scattered oak.

About 5 percent of this unit is included areas of a deep soil that does not have a claypan and supports fair stands of oak trees. About 5 percent is a soil that is similar to this Redding soil but has a yellowish brown subsoil. Also included are a few small areas where slopes are up to 20 percent.

The Redding is a well drained claypan soil that is moderately deep over a hardpan. It formed in gravelly old valley fill from mixed sources.

Typically, the surface layer is strong brown and yellowish red gravelly loam and reddish brown loam about 14 inches thick. The subsoil is dark reddish brown and reddish brown clay. At a depth of about 28 inches is the hardpan.

Permeability is very slow. The available water capacity is 1.5 to 3.0 inches. The effective rooting depth is 20 to 34 inches. Most roots in the clay subsoil are along the faces of peds, which reduces the water available to plants. Surface runoff is medium. The hazard of erosion is moderate.

The Corning is a very deep, well drained claypan soil that is underlain by gravelly alluvium. It formed in old valley fill from mixed sources.

Typically, the surface layer is reddish brown, yellowish red, and red gravelly loam about 22 inches thick. The subsoil is red and dark red clay about 18 inches thick.

The substratum to a depth of 58 inches is strong brown clay.

Permeability is very slow. The available water capacity is 4.0 to 6.5 inches. The effective rooting depth is 60 inches or more, but most roots in the clay subsoil are on the faces of peds, which reduces the water available to plants. Surface runoff is medium. The hazard of erosion is moderate.

These soils are used mainly as annual rangeland.

Most range grasses are low in nutrient content because the soils are low in fertility level. Forage production can be increased by introducing improved annuals, such as Blando bromegrass and Lana vetch, and by applying nitrogen, phosphorus, and sulfur. In a favorable year, the green feed period is from about March 15 to June 1. Grazing should be planned so that desirable vegetation is left to protect the soil from depletion and erosion. Range plants should be grazed only when the soil is dry.

These soils have limited potential as habitat for mourning dove and California quail. The lack of shrub cover is the major limitation to wildlife habitat. To encourage wildlife populations, shrub hedgerows can be established along fence lines, roadsides, and streambanks to provide needed cover and nesting areas.

There is little rural development. The major limitations to urban use are the very slow permeability in the subsoil of both soils and the hardpan under the Redding soil. These limitations restrict the proper functioning of septic tank absorption fields.

Capability unit IVe-3(17) nonirrigated; Storie index Redding 19, Corning 30.

178—Riverwash. Riverwash occurs in and along channels of the Bear and American Rivers. The material is highly stratified stony and bouldery sand that is typically barren. It is inundated yearly by floodwater. About 50 percent of it is covered with water. Riverwash is subject to scouring or cutting as well as to deposition, depending on riverflow and bedload. Included are areas of tailings.

Permeability is very rapid. The available water capacity and drainage are variable. Surface runoff is rapid. The hazard of erosion is very high.

Riverwash is used for watershed. It also provides good habitat for wildlife.

Capability subclass VIIIw(17, 18, 22); Storie index 0.

179—Rock outcrop. Rock outcrop is exposed highly resistant metamorphic rock, andesitic rock, serpentine rock, or syenite rock formations. The rock crops out mainly on steep to very steep slopes that break into the major drainageways. At the lower elevations, it is generally associated with Auburn soils. At higher elevations, it is associated with the Boomer variant, Dubakella, Mariposa, and Maymen soils. These areas are essentially barren. The only plant cover is sparse grasses and browse and stunted trees.

From 50 to 90 percent of the surface is Rock outcrop and stone. The rest is a thin mantle of soil material. Drainage is excessive. Surface runoff is very rapid. There is little or no hazard of erosion.

This unit is used for watershed. In some areas of serpentine rock, there are chromium deposits.

Capability subclass VIIIs(18, 22) nonirrigated; Storie index less than 5.

180—Rubble land. Rubble land is cobbly and stony mine debris and tailings from dredge or hydraulic mining. It is essentially barren. Grasses and brush are sparse. At higher elevations, noncommercial stands of conifer are regenerating.

Nearly all soil material either has been washed away as in hydraulic mining, or has been buried, as in dredge mining. Surface runoff and the hazard of erosion are variable.

Rubble land is used mainly for watershed. It also provides some habitat for wildlife. Some areas are a source of aggregate.

Capability subclass VIIIs(18, 22) nonirrigated; Storie index less than 5.

181—San Joaquin sandy loam, 1 to 5 percent slopes. This is a well drained claypan soil that is moderately deep over a hardpan. It is on low terraces at elevations of 50 to 200 feet. It formed in alluvium from predominantly granitic sources. The average annual precipitation is about 20 inches. The average annual air temperature is about 62 degrees F. The average frost-free season is about 270 days. Natural vegetation is annual grasses and forbs.

About 15 percent of the acreage is included areas of Cometa sandy loam, 5 percent is Fiddyment loam, and 5 percent is a soil that is similar to this San Joaquin soil but is less than 20 inches deep over a hardpan. Also included are small areas of Ramona sandy loam or Kilaga loam on scattered narrow ridges and areas of Alamo clay in some drainageways and basins.

Typically, the surface layer of this San Joaquin soil is reddish yellow sandy loam about 15 inches thick. The subsoil is reddish yellow clay loam and yellowish red clay. At a depth of about 35 inches is the hardpan.

Permeability is very slow. The available water capacity is 2.0 to 3.5 inches. The effective rooting depth is 20 to 35 inches. The dense clay subsoil restricts most roots and reduces the available moisture. Surface runoff is slow. The hazard of erosion is slight. After intense rainstorms, the soil is saturated for a short time.

Most areas are used for winter grain. When grain prices are down, much of the grainland is used as annual range. A few areas are used for irrigated pasture and rice.

To avoid compaction, this soil should not be cultivated or have equipment moved across it when wet, except in growing rice. Flood, border, or sprinkler irrigation is suitable. After a grain crop, this soil is usually fallowed in alternate years to conserve moisture and control weeds. Yields are low but can be improved by applications of nitrogen, especially when it is applied in both nitrate and ammonia form.

Irrigated pasture should consist of legumes and grasses planted in a well prepared seedbed. A typical seed mixture is narrowleaf trefoil and Akaroa orchardgrass. The legume seed is inoculated before planting. The pasture should be mowed to prevent clumping. It responds to applications of nitrogen and phosphorus. Leveling for border irrigation may expose the hardpan. The frequency of irrigation is about every 5 to 8 days during July and August. Approximately 4 to 4 1/2 acre-feet of water is used annually.

Flatter areas are well suited to rice. The soil needs to be leveled so that water can be ponded. The hardpan under this soil is nearly impervious to the downward movement of water. Water requirements for rice are about 1 cubic foot per second for 40 acres after the checks are flooded. Rice should be rotated with barley every 2 to 4 years to help control aquatic weeds and soil fungus.

This soil has fair potential for rangeland. Most rangeland is in poor condition because the forage is volunteer grasses, legumes, and forbs. Forage production can be increased by introducing improved annuals, such as Blando bromegrass and Lana vetch and by applying nitrogen, phosphorus, and sulfur. In a favorable year, the green feed period is from about March 15 to June 1. Grazing should be planned so that desirable vegetation, such as soft chess, wild oats, and filaree is maintained and enough vegetation is left to protect the soil from depletion and erosion. Range plants should be grazed only when the soil is dry.

Grainfields and rangeland have limited potential as habitat for mourning dove. Irrigated pasture and ricefields provide habitat for dove and pheasant. Ricefields provide good habitat for duck. The lack of shrub cover is the major limitation to wildlife habitat. To encourage wildlife populations, shrub hedgerows can be established along fence lines, roadsides, and streambanks to provide needed cover and nesting areas.

Some areas of this soil are used for rural subdivisions. The major limitations to urban use are the very slow permeability of the subsoil, the shrink-swell potential of the subsoil, the moderate depth to the hardpan, and the limited ability of the soil to support a load. Dwellings can be designed to offset the low bearing strength, the shrink-swell potential, and the moderate depth to the hardpan. Septic tank absorption fields may not function properly because of the very slowly permeable subsoil and the depth to hardpan, which is generally less than 35 inches.

Capability unit IVe-3(17) irrigated and nonirrigated; Storie index 31.

182—San Joaquin-Cometa sandy loams, 1 to 5 percent slopes. These undulating soils are on low terraces at elevations of 50 to 200 feet. The unit is about 40 percent San Joaquin soil and 30 percent Cometa soil. Both soils have a claypan. The San Joaquin soil has a hardpan under the claypan. The Cometa soil has compacted alluvium under the claypan. The average annual precipitation is about 20 inches. The average annual air temperature is about 62 degrees F. The average frost-free season is about 270 days. Natural vegetation is annual grasses and forbs.

About 10 percent of this unit is included areas of Fiddyment loam, 5 percent is Kaseberg loam, 10 percent is Ramona sandy loam and Kilaga loam on scattered knolls, and 5 percent is Alamo clay in some drainageways and basins.

The San Joaquin is a well drained claypan soil that is moderately deep over a hardpan. It formed in alluvium from predominantly granitic sources.

Typically, the surface layer is reddish yellow sandy loam about 15 inches thick. The subsoil is reddish yellow clay loam and yellowish red clay. At a depth of about 35 inches is the hardpan.

Permeability is very slow. The available water capacity is 2.0 to 3.5 inches. The effective rooting depth is 20 to 35 inches. The dense clay subsoil restricts most roots and thus reduces the water available to plants. Surface runoff is slow. The hazard of erosion is slight. After intense rainstorms, the soil is saturated for a short time.

The Cometa is a deep, well drained claypan soil. It formed in alluvium, mainly from granitic sources.

Typically, the surface layer is brown sandy loam about 18 inches thick. The subsoil is brown clay. At a depth of about 29 inches is very pale brown sandy loam that is slightly compacted.

Permeability is very slow. The available water capacity is 5.0 to 6.5 inches. The effective rooting depth is 60 inches or more, but most roots in the clay subsoil are along the faces of peds, which reduces the water available to plants. Surface runoff is slow. The hazard of erosion is slight. After intense rainstorms, the soil is saturated for a short time.

Most areas are used for winter grain. A few areas are used for irrigated pasture and rice. Sometimes much of the grainland is used as annual rangeland.

To avoid compaction, this unit should not be cultivated or have equipment moved across it when wet, except in growing rice. Flood, border, or sprinkler irrigation is suitable. After a grain crop, these soils are usually fallowed in alternate years to conserve moisture and control weeds. Yields are low but can be improved by applications of nitrogen, especially when it is applied in both nitrate and ammonia form.

Irrigated pasture can be a combination of legumes and grasses planted in a well prepared seedbed. A typical seed mixture is narrowleaf trefoil and Akaroa orchardgrass. The legume seed is inoculated before planting.

The pasture should be mowed to prevent clumping. It responds to applications of nitrogen and phosphorus. Leveling for border irrigation on the San Joaquin soil may expose areas of dense clay or the hardpan. Leveling the Cometa soil may expose areas of the dense clay subsoil. The frequency of irrigation is about every 5 to 8 days during July and August. Approximately 4 to 4 1/2 acre-feet of water is used annually.

Flatter areas are well suited to rice. The soil should be leveled so that water can be ponded. The hardpan under the San Joaquin soil and the clay subsoil and substratum of the Cometa soil are nearly impervious to the downward movement of water. Water requirements for rice are about 1 cubic foot per second for 40 acres after the checks are flooded. Rice should be rotated with barley every 2 to 4 years to help control aquatic weeds and soil fungus.

This unit has fair potential as rangeland. Most of the rangeland is in poor condition because the forage is volunteer grasses, legumes, and forbs. Forage production can be increased by introducing improved annuals, such as Blando bromegrass and Lana vetch, and by applying nitrogen, phosphorus, and sulfur. In a favorable year, the green feed period is from about March 15 to June 1. Grazing should be planned so that desirable vegetation, such as soft chess, wild oats, and filaree is maintained and enough vegetation is left to protect the soil from depletion and erosion. Range plants should be grazed only when the soil is dry.

Grainfields and rangeland have limited potential as habitat for mourning dove. Irrigated pasture and ricefields provide habitat for doves and pheasant. Ricefields provide good habitat for ducks. The lack of shrub cover is the major limitation to wildlife habitat. To encourage wildlife populations, shrub hedgerows can be established along fence lines, roadsides, and streambanks to provide needed cover and nesting areas.

Some rural development is beginning on this unit. The major limitations to construction on the Cometa soil are the very slow permeability of the subsoil, the shrink-swell potential, and the limited ability of the soil to support a load. The major limitations to construction on the San Joaquin soil are the very slow permeability of the subsoil, the moderate depth to the hardpan, the shrink-swell potential, and the limited ability of the soil to support a load. Dwelling and road construction can be designed to offset the shrink-swell potential and the low bearing strength of the soils. Community sewage systems must be anticipated in rural subdivisions. Septic tank absorption fields may not function properly because of the very slow permeability in the subsoil of both soils, the substratum of the Cometa soil, and the hardpan under the San Joaquin soil.

Capability unit IVe-3(17) irrigated and nonirrigated; Storie index 34.

183—Sierra sandy loam, 2 to 9 percent slopes. This is a deep, gently rolling, well drained soil underlain by weathered granitic rock. It formed in residuum on low foothills at elevations of 200 to 1,000 feet. It occurs as scattered areas throughout the Loomis Basin. The average annual precipitation ranges from 22 to 33 inches. The average annual air temperature is about 61 degrees F. The average frost-free season is between 250 and 270 days. Natural vegetation is annual grasses, forbs, blue and live oak, and scattered pine.

About 15 percent of the acreage is included areas of Andregg coarse sandy loam, 5 percent is a soil that is similar to this Sierra soil but is 20 to 40 inches deep to weathered rock, and 5 percent is another soil that is similar to this Sierra soil but has a light yellowish brown and brown sandy clay loam subsoil. In some swales there is dark colored, poorly drained soil. Near Folsom Lake, there are small areas where this Sierra soil has a thin gravel mantle from old valley fill. About 2 percent of the acreage is scattered rock outcrop.

Typically, the surface layer of this Sierra soil is dark grayish brown, brown, and yellowish red sandy loam about 23 inches thick. The subsoil is yellowish red sandy clay loam and red clay loam. At a depth of 41 inches is highly weathered granodiorite.

Permeability is moderately slow. The available water capacity is 5.0 to 9.5 inches. The effective rooting depth is 40 to 60 inches or more. Surface runoff is medium. The hazard of erosion is moderate.

This soil is used mainly for irrigated pasture and deciduous orchards. Small, scattered areas are used as rangeland. Many areas in orchards are now being subdivided and used for rural or ranchette housing.

Erosion can be controlled by tilling across the slope and by using cover crops in orchards in winter. Cultivation should be limited to the control of weeds. To avoid compaction, this soil should not be cultivated or have equipment moved across it when wet. Sprinklers should be used in irrigating.

Wimmera 62 ryegrass, Blando bromegrass, or Cucamonga bromegrass provide a satisfactory cover crop in orchards. The annual cover should set seed before it is disked or mowed.

In deciduous orchards, a permanent cover crop can be annual grasses and weeds, which are mowed. A perennial permanent sod cover should consist of low growing legumes and perennial grasses, such as white Dutch clover, Salina strawberry clover, and Pomar orchardgrass. It should be mowed in spring and summer through fruit harvest. No legumes should be used in a cover crop in apple orchards.

Irrigated pasture can be a combination of legumes and grasses planted in a well prepared seedbed. A typical seed mixture is narrowleaf trefoil and Akaroa orchardgrass. The legume seed is inoculated before planting. The pasture should be mowed to prevent clumping.

fruit harvest. No legumes should be used in a cover crop in apple orchards.

Irrigated pasture can be a combination of legumes and grasses planted in a well prepared seedbed. A typical seed mixture is narrowleaf trefoil and Akaroa orchardgrass. The legume seed is inoculated before planting. The pasture should be mowed to prevent clumping.

All crops respond to applications of nitrogen and phosphorus. Potassium is usually adequate. Orchards may need small applications of zinc. In orchards under permanent cover, fertilizer rates are generally increased by about 50 percent. Range legumes respond to applications of sulfur.

On pasture and in deciduous orchards, irrigation water is applied by sprinklers at a rate of 0.25 to 0.35 inch per hour. A total of 3.0 to 4.5 inches of water is applied at each irrigation. The frequency of irrigation is every 6 to 10 days during July and August. Approximately 3 1/2 acre-feet of water is used annually.

This soil has good potential as rangeland. Forage production can be increased by introducing improved annuals, such as Blando bromegrass and Lana vetch, and improved perennial dryland grasses, such as Perlagrass, planted in a well prepared seedbed. In a favorable year, the green feed period is from about March 15 to June 15. Grazing should be planned so that desirable vegetation, such as soft chess, wild oats, and filaree, is maintained and enough vegetation is left to protect the soil from depletion and erosion. Range plants should be grazed only when the soil is dry. Oak thickets can be thinned to increase forage.

Orchard and pasture areas have good potential as habitat for California quail, mourning dove, and pheasant. Wooded areas provide habitat for black-tailed deer, gray squirrel, and wild turkey. To encourage wildlife populations, shrub hedgerows can be established along fence lines, roadsides, and streambanks to provide needed cover and nesting areas. Protective strip plantings of grain provide food. Deer present serious depredation problems in orchards.

This soil is used increasingly as sites for rural subdivisions. The major limitation to urban use is the depth to rock. Community sewage systems must be anticipated in medium and high density subdivisions. Septic tank absorption fields may not function properly because the depth to rock is generally less than 40 inches.

Capability unit IIIe-8(18) irrigated and nonirrigated; Storie index 61.

192—Xerofluvents, sandy. Xerofluvents, sandy, consist of small areas of moderately well drained, stratified sandy alluvium adjacent to the Bear River near Sheridan. Included is a small area below Halsey Forbay consisting of sandy alluvium deposited from cleaning the Forbay. Natural vegetation is annual grasses, forbs, cottonwood, and willow.

These are variable brown and grayish brown, stratified sands and loamy sands. The subsoil has thin lenses of silt and loam.

Permeability is moderately rapid or rapid. The available water capacity is 3 to 5 inches. The effective rooting depth is 60 or more inches. Surface runoff is slow. The hazard of erosion is slight. A water table rises in winter but drops below 60 inches late in spring. These soils are occasionally flooded by stream overflow.

Where protected by levees along the Bear River, these soils are used for row crops and deciduous orchards. Green manure crops should be grown to maintain the level of organic matter and to improve soil tilth and water penetration. Generally all crops respond to applications of nitrogen, phosphorus, and potassium. Furrows and sprinklers are suitable for irrigation.

Undeveloped areas have good potential as cover and nesting habitat for mourning dove and pheasant.

Xerofluvents, sandy, are not suited to urban use because of the flood hazard.

Capability unit IIIs-2(17) irrigated and nonirrigated; Storie index 43.

193—Xerofluvents, occasionally flooded. Xerofluvents, occasionally flooded, consist of small areas of moderately well drained loamy alluvium adjacent to stream channels. Natural vegetation is annual grasses, forbs, and valley oak.

These are variable colored, stratified sandy loams, loams, silt loams, and clay loams that generally become gravelly with increasing depth. The depth to underlying restrictive material is greater than 60 inches.

Permeability is moderate to moderately slow. The available water capacity is 8 to 10 inches. The effective rooting depth is greater than 60 inches. Surface runoff is slow. The hazard of erosion is slight. The water table rises to within 30 to 48 inches of the surface during the rainy season but drops below 60 inches late in spring. Some areas near the Sutter County line are somewhat poorly drained as a result of the irrigation of adjacent land. These soils are occasionally flooded by stream overflow.

Where protected by levees along the Bear River, these soils are used for row crops and deciduous orchards. Much of the acreage that occurs as long, narrow stringers along minor streams is used with adjacent soils. Generally all crops respond to applications of nitrogen, phosphorus, and potassium. Borders, furrows, and sprinklers are suitable for irrigation. The kind of irrigation, however, is generally governed by the crop grown.

Undeveloped areas adjacent to streams have good potential as cover and nesting habitat for mourning dove and pheasant.

These soils are not suited to urban use because of the flood hazard.

Capability unit IIw-2(17, 18) irrigated and nonirrigated; Storie index 69.

194—Xerofluvents, frequently flooded. Xerofluvents, frequently flooded, consist of narrow stringers of somewhat poorly drained recent alluvium adjacent to stream channels. Natural vegetation is annual grasses, forbs, sedges, valley oak, and willow.

These are variable colored, stratified gravelly sandy loams, gravelly loams, and gravelly clay loams that generally grade to sand and gravel with increasing depth. The depth to underlying restrictive material is greater than 36 inches.

Permeability is variable. The available water capacity is 2.5 to 6 inches. The effective rooting depth is greater than 36 inches. Surface runoff is slow. The hazard of erosion is high. Areas are subject to frequent flooding and channelization.

Because of the frequent flooding, most of the acreage is idle. Some of the acreage is pasture. A plant cover is needed in winter to protect these soils from erosion and channelization during periods of flooding.

Idle areas have good potential as cover and nesting habitat for wildlife.

These Xerofluvents are not suited to urban use because of the flood hazard.

Capability unit IVw-2(17, 18, 22) irrigated and nonirrigated; Storie index 36.

195—Xerofluvents, hardpan substratum. Xerofluvents, hardpan substratum, consist of small areas of somewhat poorly drained loamy alluvium in minor drainageways on terraces. Natural vegetation is annual grasses, forbs, and sedges.

These are variable colored, stratified loams and clay loams. Depth to the underlying hardpan ranges from 20 to 36 inches. About 20 percent of the area is Alamo clay.

Permeability is moderately slow. The available water capacity is 2.5 to 5 inches. The effective rooting depth is 20 to 36 inches. Surface runoff is slow. The hazard of erosion is slight. The water table rises to within 20 inches of the surface in winter, but disappears late in spring. These soils are occasionally flooded by stream overflow.

The use of these soils generally is the same as that of adjacent soils. Most areas are cultivated. Crops commonly grown are winter grain, irrigated pasture, and rice. A protective strip of vegetation left on each side of the channel can prevent the meandering of stream channels through areas of these soils.

Capability unit IIIw-2(17) irrigated and nonirrigated; Storie index 47.

196—Xerorthents, cut and fill areas. Xerorthents, cut and fill areas, consist of mechanically removed and mixed soil material in which horizons are no longer discernible. Most of this material is in the right-of-way of Interstate 80, the town of Auburn, and the Southern Pacific trainyard in Roseville. Some fill areas contain rocks, concrete, asphalt, and other debris. Included are small areas of similar soils.

Cut and fill areas are typically well drained. Surface runoff is very rapid. The hazard of erosion is moderate. Permeability and available water capacity are variable.

These cut and fill areas are used primarily for highways and urban development.

Capability subclass VIIIs(17, 18, 22) nonirrigated; Storie index less than 10.

197—Xerorthents, placer areas. Xerorthents, placer areas, consist of stony, cobbly, and gravelly material commonly adjacent to streams that have been placer mined. Natural vegetation varies but generally is annual grasses, browse, oak, alder, willow, and cottonwood.

The soil material is derived from a mixture of rocks. It is stratified or poorly sorted. It contains enough fine sand and silt to support some grass. Depth of soil material ranges from 6 inches to more than 5 feet. Permeability, available water capacity, runoff, erosion hazard, and drainage are variable. Areas in streambeds are frequently flooded during the rainy season.

These soils have some value for grazing and for watering livestock. They also provide a good cover and water for wildlife.

Capability subclass VIIs(17, 18, 22) nonirrigated; Storie index less than 5.

Use and management of the soils

The soil survey is a detailed inventory and evaluation of the most basic resource of the survey area—the soil. It is useful in adjusting land use, including urbanization, to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in uses of the land.

While a soil survey is in progress, soil scientists, conservationists, engineers, and others keep extensive notes about the nature of the soils and about unique aspects of behavior of the soils. These notes include data on erosion, drought damage to specific crops, yield estimates, flooding, the functioning of septic tank disposal systems, and other factors affecting the productivity, potential, and limitations of the soils under various uses and management. In this way, field experience and measured data on soil properties and performance are used as a basis for predicting soil behavior.

Information in this section is useful in planning use and management of soils for crops and pasture, rangeland, and woodland, as sites for buildings, highways and other transportation systems, sanitary facilities, and parks and other recreation facilities, and for wildlife habitat. From the data presented, the potential of each soil for specified land uses can be determined, soil limitations to these land uses can be identified, and costly failures in houses and other structures, caused by unfavorable soil of water erosion is high. The shrink-swell potential is high.

The Dibble soil is moderately deep and well drained. It formed in residuum derived dominantly from interbedded sandstone and shale. Typically, the surface layer is light yellowish brown silty clay loam about 5 inches thick. The subsoil is brownish yellow clay about 11 inches thick. The underlying material to a depth of 22 inches is yellow clay. Soft sandstone and shale are at a depth of 22 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Dibble soil is slow. Available water capacity is low to moderate. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high. The shrink-swell potential is high.

This unit is used as rangeland.

If this unit is used as rangeland, it is limited mainly by slope. Steepness of slope limits access by livestock and results in overgrazing of the less sloping areas. Proper placement of livestock watering facilities and salt improves distribution of livestock. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Livestock grazing should be managed to protect the unit from erosion. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. The present vegetation on this unit is mainly soft chess, wild oat, fescue, and filaree.

This map unit is in capability subclass VIe (18), nonirrigated.

103—Byington silt loam, 0 to 2 percent slopes. This very deep, poorly drained, saline-sodic soil is on flood plains. It formed in alluvium derived from mixed sources. Elevation is 20 to 50 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is light olive gray silt loam about 13 inches thick. The underlying material to a depth of 60 inches or more is pale brown, olive gray, light brownish gray, and light yellowish brown, stratified silt loam and silty clay loam.

Included in this unit are small areas of Columbia, Nueva, and Shanghai soils. Also included are small areas of a soil that is similar to this Byington soil but has a higher salt and sodium content. Included areas make up about 15 percent of the total acreage.

Permeability of this Byington soil is moderate. Available water capacity is high to very high. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 24 to 36 inches in December through April. Runoff is very slow, and the hazard of water erosion is slight. This soil is protected by levees and is subject to rare periods of flooding.

Most areas of this unit are used for irrigated crops, mainly rice. Among the other crops grown are tomatoes, corn, and grain sorghum. Some areas are used for nonirrigated wheat and barley.

This unit is suited to irrigated crops and nonirrigated wheat and barley. It is limited mainly by the salt and sodium content and the high water table. Salinity and sodicity may reduce production of sensitive crops. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Tile or open drains can be used to remove excess water. Content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil.

The map unit is in capability units IIw-6 (17), irrigated, and IIIw-6 (17), nonirrigated.

104—Capay silty clay, 0 to 2 percent slopes. This very deep, moderately well drained soil is in basins and on basin rims. It formed in alluvium derived from mixed sources. Elevation is 20 to 50 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is dark grayish brown silty clay about 36 inches thick. The underlying material to a depth of 60 inches or more is brown and light yellowish brown clay loam. In some areas the soil is clay throughout.

Included in this unit are small areas of Clear Lake, Gridley, and Oswald soils. Included areas make up about 30 percent of the total acreage.

Permeability of this Capay soil is slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight. The shrink-swell potential is high. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated crops, mainly rice and tomatoes. Among the other crops grown are corn, sugar beets, dry beans, safflower, and grain sorghum. Some areas are used for nonirrigated wheat and barley and for irrigated hay and pasture.

This unit is suited to irrigated crops. It is limited mainly by slow permeability. Furrow, border, and corrugation irrigation systems are suited to this unit. Sprinkler irrigation can be used, but water needs to be applied slowly to minimize runoff. The method used generally is governed by the crop grown. Because of the slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production.

This unit is suited to irrigated hay and pasture. Grasses and legumes grow well if adequate fertilizer is used. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff. Excess water on the surface can be removed by grading to a suitable outlet and providing drainage ditches.

Nonirrigated areas of this unit are suited to small grain. The main limitation is slow permeability. Because of the slow permeability and wetness that results from winter rains, small grain should be planted in raised beds.

This map unit is in capability units IIs-5 (17), irrigated, and IIIs-5 (17), nonirrigated.

105—Capay silty clay, occasionally flooded, 0 to 2 percent slopes. This very deep, moderately well drained soil is in basins and on basin rims. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is dark grayish brown silty clay about 36 inches thick. The underlying material to a depth of 60 inches or more is brown and light yellowish brown clay loam. In some areas the surface layer is clay.

Included in this unit are small areas of Clear Lake, Gridley, Liveoak, and Oswald soils. Included areas make up about 20 percent of the total acreage.

Permeability of this Capay soil is slow. Available water capacity is high. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 48 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is slight. The shrink-swell potential is high. This soil is subject to occasional, brief periods of flooding in December through April.

Most areas of this unit are used for irrigated crops, mainly rice. Among the other crops grown are corn, safflower, and grain sorghum. Some areas are used for nonirrigated wheat and barley.

This unit is suited to rice, field crops, and small grain. It is limited mainly by slow permeability and wetness because of flooding. Furrow, border, and corrugation irrigation systems are suited to this unit. Sprinkler irrigation can be used, but water needs to be applied slowly to minimize runoff. The method used generally is governed by the crop grown. Because of the slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production. Field ditches and pipe drops or other outlets are needed to remove excess water from the surface.

If this unit is used for nonirrigated crops, the main limitation is flooding. Small grain should be planted in raised beds.

This map unit is in capability units IIw-5 (17), irrigated, and IIIw-5 (17), nonirrigated.

106—Capay silty clay, frequently flooded, 0 to 2 percent slopes. This very deep, moderately well drained soil is in basins. It formed in alluvium derived from mixed sources. Elevation is 20 to 50 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is dark grayish brown silty clay about 36 inches thick. The underlying material to a depth of 60 inches or more is brown clay loam. In some areas the soil is clay throughout.

Included in this unit are small areas of Clear Lake, Gridley, Liveoak, and Oswald soils. Included areas make up about 20 percent of the total acreage.

Permeability of this Capay soil is slow. Available water capacity is high. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 48 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is slight. The shrink-swell potential is high. This soil is subject to frequent, long periods of flooding in December through April.

Most areas of this unit are used for irrigated crops, mainly rice and tomatoes. Among the other crops grown are corn, dry beans, grain sorghum, and safflower.

This unit is suited to field crops and rice. It is limited mainly by slow permeability and wetness because of flooding. Furrow, border, and corrugation irrigation systems are suited to this unit. Sprinkler irrigation can be used, but water needs to be applied slowly to minimize runoff. The method used is generally governed by the crop grown. Because of the slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production. Field ditches and pipe drops or other outlets are needed to remove excess water.

This map unit is in capability unit IVw-5 (17), irrigated and nonirrigated.

107—Capay silty clay, siltstone substratum, 0 to 2 percent slopes. This deep, moderately well drained soil is in basins and on basin rims. It formed in alluvium derived from mixed sources. Elevation is 20 to 50 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is dark grayish brown silty clay about 32 inches thick. The underlying material to a depth of 50 inches is brown clay loam over siltstone.

Depth to siltstone ranges from 40 to 60 inches. In some areas the soil is clay throughout.

Included in this unit are small areas of Clear Lake, Gridley, and Oswald soils. Included areas make up about 15 percent of the total acreage.

Permeability of this Capay soil is slow. Available water capacity is moderate to high. Effective rooting depth is 40 to 60 inches. A perched water table is at a depth of 36 to 60 inches year round. Runoff is very slow, and the hazard of water erosion is slight. The shrink-swell potential is high. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated crops, mainly rice. Among the other crops grown are tomatoes, corn, grain sorghum, and dry beans. Some areas are used for irrigated hay and pasture and for nonirrigated small grain.

This unit is suited to irrigated crops. It is limited mainly by slow permeability. Furrow, border, and corrugation irrigation systems are suited to this unit. Sprinkler irrigation can be used, but water needs to be applied slowly to minimize runoff. The method used generally is governed by the crop grown. Because of the slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production.

This unit is suited to irrigated hay and pasture. Grasses and legumes grow well if adequate fertilizer is used. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff. Excess water on the surface can be removed by grading to a suitable outlet and providing drainage ditches.

Nonirrigated areas of this unit are suited to small grain. The unit is limited mainly by slow permeability. Because of this slow permeability and wetness that results from winter rains, small grain should be planted in raised beds.

This map unit is in capability units IIw-5 (17), irrigated, and IIIw-5 (17), nonirrigated.

108—Capay silty clay, wet, 0 to 2 percent slopes. This very deep, moderately well drained soil is in basins. It formed in alluvium derived from mixed sources. Elevation is 20 to 50 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is grayish brown silty clay about 16 inches thick. The underlying material to a depth of 60 inches or more is pale brown clay loam. In some areas the surface layer is clay.

Included in this unit are small areas of Clear Lake, Gridley, Liveoak, and Oswald soils. Included areas make up about 20 percent of the total acreage.

Permeability of this Capay soil is slow. Available water capacity is high to very high. Effective rooting depth is 60 inches or more. A water table is at a depth of 48 to 60 inches year round. Runoff is very slow, and the hazard of water erosion is slight. The shrink-swell potential is high. This soil is protected by levees; therefore, it is subject only to rare periods of flooding.

Most areas of this unit are used for irrigated crops, mainly rice and tomatoes. Among the other crops grown are dry beans, corn, safflower, and grain sorghum. Some areas are used for nonirrigated wheat and barley.

This unit is suited to irrigated crops. It is limited mainly by slow permeability and poor drainage. Furrow, border, and corrugation irrigation systems are suited to this unit. Sprinkler irrigation can be used, but water needs to be applied slowly to minimize runoff. The method used generally is governed by the crop grown. Irrigation water needs to be applied carefully to prevent the buildup of a high water table. Drainage may also be needed. Because of the slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production.

Nonirrigated areas of this unit are suited to small grain. The main limitation is the slow permeability of the soil. Because of the slow permeability and wetness that results from winter rains, small grain should be planted in raised beds.

This map unit is in capability units IIw-5 (17), irrigated, and IIIw-5 (17), nonirrigated.

109—Capay clay, hardpan substratum, 0 to 2 percent slopes. This deep, moderately well drained soil is in basins and on basin rims. It formed in alluvium derived from mixed sources. Elevation is 20 to 50 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is grayish brown and dark grayish brown clay about 26 inches thick. The next layer to a depth of 42 inches is pale brown clay loam. The next layer is a strongly cemented hardpan 4 inches thick. Below this to a depth of 60 inches or more is light yellowish brown loam. Depth to the hardpan ranges from 40 to 60 inches.

Included in this unit are small areas of Galt and Jacktone soils and Clear Lake soils that have a hardpan. Also included are small areas of a soil that is similar to this Capay soil but is only weakly cemented at a depth of 40 to 60 inches. Included areas make up about 20 percent of the total acreage.

Permeability of this Capay soil is slow. Available water capacity is moderate to high. Effective rooting depth is 40 to 60 inches. Runoff is slow, and the hazard of water erosion is slight. The shrink-swell potential is high. This soil is protected by levees; therefore, it is subject only to rare periods of flooding.

Most areas of this unit are used for irrigated rice. A few areas are used for irrigated tomatoes, sugar beets, and field corn and for nonirrigated small grain.

This unit is suited to irrigated crops. It is limited mainly by slow permeability. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. If sprinkler irrigation is used, water needs to be applied slowly to minimize runoff. Because of the slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production. Tilth and fertility can be improved by returning crop residue to the soil.

Nonirrigated areas of this unit are suited to small grain. The main limitation is slow permeability. Because of the slow permeability and wetness that results from winter rains, small grain should be planted in raised beds.

The map unit is in capability units IIs-5 (17), irrigated, and IIIs-5 (17) nonirrigated.

110—Clear Lake silt loam, 0 to 2 percent slopes. This very deep soil is on flood plains and basin rims and in basins. Under natural conditions the soil is poorly drained; however, drainage has been improved by the use of open ditches and flood control structures. This soil formed in alluvium derived from mixed sources. Elevation is 20 to 50 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is yellowish brown silt loam about 15 inches thick. Below this is a buried surface layer of dark gray clay 35 inches thick. The underlying material to a depth of 60 inches or more is grayish brown and light yellowish brown clay. In some areas the surface layer is loam or fine sandy loam.

Included in this unit are small areas of Capay, Oswald, and Subaco soils and Clear Lake Clay. Included areas make up about 15 percent of the total acreage.

Permeability of this Clear Lake soil is moderate to a depth of 15 inches and slow below this depth. Available water capacity is high. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 36 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is slight. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated crops, mainly rice. Among the other crops grown are corn, tomatoes, grain sorghum, dry beans, and safflower.

This unit is suited to irrigated crops. It is limited mainly by slow permeability and poor drainage. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Irrigation water needs to be applied carefully to prevent the buildup of a high water table. Drainage may also be needed. Because of the slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production.

This map unit is in capability units IIw-5 (17), irrigated, and IIIw-5 (17), nonirrigated.

111—Clear Lake silt loam, frequently flooded, 0 to 2 percent slopes. This very deep soil is on flood plains and in basins. Under natural conditions the soil is poorly drained; however, drainage has been improved by the use of open ditches and flood control structures. This soil formed in alluvium derived from mixed sources. Elevation is 20 to 50 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is yellowish brown silt loam about 15 inches thick. Below this is a buried surface layer of dark gray clay 35 inches thick. The underlying material to a depth of 60 inches or more is gray and light yellowish brown clay. In some areas the surface layer is loam, sandy loam, or fine sandy loam.

Included in this unit are small areas of Capay, Oswald, and Subaco soils and Clear Lake clay. Included areas make up about 15 percent of the total acreage.

Permeability of this Clear Lake soil is moderate to a depth of 15 inches and slow below this depth. Available water capacity is high. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 36 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is slight. This soil is subject to frequent, long periods of flooding in December through April.

Most areas of this unit are used for irrigated crops, mainly rice. Among the other crop grown are tomatoes, corn, grain sorghum, dry beans, and safflower.

This unit is suited to irrigated crops. It is limited mainly by slow permeability, poor drainage, and wetness because of flooding. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Irrigation water needs to be applied carefully to prevent the buildup of a high water table. Drainage may also be needed. Because of the slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production. Field ditches and pipe drops or other outlets are needed to remove excess water from the surface.

This map unit is in capability unit IVw-2 (17), irrigated and nonirrigated.

112—Clear Lake clay, 0 to 2 percent slopes. This very deep soil is in basins. Under natural conditions the soil is poorly drained; however, drainage has been improved by the use of open ditches and flood control structures. This soil formed in alluvium derived from mixed sources. Elevation is 20 to 50 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is dark gray clay about 42 inches thick. The underlying material to a depth of 60 inches or more is olive gray clay.

Included in this unit are small areas of Capay, Oswald, and Subaco soils. Included areas make up about 10 percent of the total acreage.

Permeability of this Clear Lake soil is slow. Available water capacity is high. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 48 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is slight. The shrink-swell potential is high. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated crops, mainly rice and tomatoes. Among the other crops grown are corn, sugar beets, grain sorghum, safflower, and dry beans. Some areas are used for nonirrigated wheat and barley.

This unit is suited to irrigated crops. It is limited mainly by slow permeability. Furrow, border, and corrugation irrigation systems are suited to this unit. Sprinkler irrigation can be used, but water needs to be applied slowly to minimize runoff. The method used generally is governed by the crop grown. Because of the slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil us used for rice production.

Nonirrigated areas of this unit are suited to small grain. The main limitation is slow permeability. Because of the slow permeability and wetness that results from winter rains, small grain should be planted in raised beds.

This map unit is in capability units IIw-5 (17), irrigated, and IIIw-5 (17), nonirrigated.

113—Clear Lake clay, frequently flooded, 0 to 2 percent slopes. This very deep soil is in basins. Under natural conditions the soil is poorly drained; however, drainage has been improved by the use of open ditches and flood control structures. This soil formed in alluvium derived from mixed sources. The native vegetation is mainly tules and water grasses. Elevation is 20 to 50 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is dark gray clay about 42 inches thick. The underlying material to a depth of 60 inches or more is olive gray clay.

Included in this unit are small areas of Capay, Oswald, and Subaco soils. Included areas make up about 15 percent of the total acreage.

Permeability of this Clear Lake soil is slow. Available water capacity is high. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 36 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is slight. The shrink-swell potential is high. This soil is subject to frequent, long periods of flooding in December through April.

Most areas of this unit are used for irrigated crops, mainly rice. Among the other crops grown are tomatoes, corn, dry beans, grain sorghum, and safflower. Some areas are also used for wildlife habitat.

This unit is suited to field crops, including rice. It is limited mainly by slow permeability, poor drainage, and wetness as a result of flooding. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Irrigation water needs to be applied carefully to prevent the buildup of a high water table. Drainage may also be needed. Because of the slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production. Field ditches and pipe drops or other outlets are needed to remove excess water.

If this unit is used for wildlife habitat, it is managed mainly for waterfowl. It has few limitations. Where waterfowl are nesting, it is important to provide and maintain a stable water level in spring. If fields are shaped for ponds, at least one natural mound 30 feet in diameter should be left per 2 acres of pond area. Mounds that are at least 2 feet above the normal water level provide dry nesting areas for waterfowl. Water depth and inundation period should be managed to encourage the growth of desirable natural vegetation. Excessive growth of undesirable vegetation such as cattail and tules can be effectively controlled by periodic burning and disking.

This map unit is in capability unit IVw-2 (17), irrigated and nonirrigated.

114—Clear Lake clay, hardpan substratum, 0 to 2 percent slopes. This deep soil is in basins and on basin rims. Under natural conditions the soil is poorly drained; however, drainage has been improved by the use of open ditches and flood control structures. This soil formed in alluvium derived from mixed sources. Elevation is 10 to 40 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

and the hazard of water erosion is slight. The shrink-swell potential is high. This soil is subject to frequent, long periods of flooding from December through April.

This unit is used for wildlife habitat.

This unit is suited to wildlife habitat. It has few limitations. Where waterfowl are nesting, it is important to provide and maintain a stable water level during spring. If fields are shaped for ponds, at least one natural mound 30 feet in diameter should be left per 2 acres of pond area. High mounds that extend at least 2 feet above the normal water level provide dry nesting areas for waterfowl. Water depth and inundation period should be managed to encourage the growth of desirable natural vegetation. Excessive growth of undesirable vegetation such as cattail and tule can also be effectively controlled by periodic burning and disking.

This map unit is in capability unit IVw-2 (17), irrigated and nonirrigated.

117—Columbia fine sandy loam, 0 to 2 percent slopes. This very deep, somewhat poorly drained soil is on flood plains. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is pale brown and brown fine sandy loam about 14 inches thick. The underlying material to a depth of 60 inches or more is stratified, pale brown and light yellowish brown fine sandy loam and light yellowish brown very fine sandy loam. In some areas the surface layer is sandy loam or silt loam.

Included in this unit are small areas of Byington and Holillipah soils, Shanghai silt loam, and Tisdale soils. Included areas make up about 20 percent of the total acreage.

Permeability of this Columbia soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 36 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is slight. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated orchard crops, mainly walnuts, prunes, and peaches. Among the other crops grown are corn, alfalfa, tomatoes, and dry beans. Some areas are used for nonirrigated wheat and barley.

This unit is suited to irrigated crops. It has few limitations. Furrow, trickle, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Fertilizer applications should be regulated to prevent contamination of ground water. Tilth and fertility can be improved by returning crop residue to the soil.

If this unit is used for nonirrigated wheat and barley, the main limitation is the moderate available water capacity.

This map unit is in capability units IIs-4 (17), irrigated, and IIIs-4 (17), nonirrigated.

118—Columbia fine sandy loam, channeled, 0 to 2 percent slopes. This very deep, somewhat poorly drained soil is on flood plains. It formed in alluvium derived from mixed sources. Areas of this unit are cut by channels of abandoned streams and are marked by higher depositional bars made during flooding (fig. 1). The native vegetation is mainly trees with a dense brush understory. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is pale brown and brown fine sandy loam about 14 inches thick. The underlying material to a depth of 60 inches or more is stratified, pale brown and light yellowish brown fine sandy loam and light yellowish brown very fine sandy loam. In some areas the surface layer is sandy loam or silt loam.

Included in this unit are small areas of Holillipah soils, Shanghai silt loam, and Tisdale soils. Included areas make up about 20 percent of the total acreage.

Permeability of this Columbia soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 36 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is severe. This soil is subject to frequent, long periods of flooding from December through April.

Most areas of this unit are used for irrigated orchard crops, mainly walnuts. Among the other crops grown are peaches, prunes, pears, and tomatoes. Some areas are used for wildlife habitat.

This unit is suited to irrigated orchard crops. It is limited mainly by the hazard of flooding. Maintaining areas of trees and brush adjacent to rivers is important for streambank stabilization and erosion control. Maintaining a cover crop in orchards helps to control erosion during periods of flooding. Sprinkler irrigation is the most suitable method of applying water. Use of this method permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. Water should be applied in amounts sufficient to wet the root zone but in amounts small enough to minimize the leaching of plant nutrients. Tilth and fertility can be improved by returning crop residue to the soil.

This unit is suited to wildlife habitat. It has few limitations. The many different kinds of vegetation in this unit support a variety of wildlife such as raptors, shore birds, waterfowl, upland game birds, and fur-bearing

Figure 1.—A drainageway in an area of Columbia fine sandy loam, channeled, 0 to 2 percent slopes.

mammals. Management consists primarily of protecting existing vegetation, especially in areas adjacent to rivers.

This map unit is in capability unit IVw-2 (17), irrigated and nonirrigated.

119—Columbia fine sandy loam, clay substratum, 0 to 2 percent slopes. This very deep, somewhat poorly drained soil is on flood plains. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is light gray and pale brown fine sandy loam about 15 inches thick. The upper 37 inches of the underlying material is stratified, pale brown and light gray fine sandy loam, sand, very fine sandy loam, and silt loam, and the lower part to a depth of 60 inches or more is black and very dark gray clay.

Included in this unit are small areas of Holillipah loamy sand and Shanghai silt loam. Included areas make up about 20 percent of the total acreage.

Permeability of this Columbia soil is moderately rapid to a depth of 52 inches and slow below this depth. Available water capacity is moderate. Effective rooting depth is 40 to 60 inches. A seasonal high water table is at a depth of 36 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is slight. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated orchard crops, mainly peaches and prunes. Among the other crops grown are corn, tomatoes, rice, dry beans, safflower, and grain sorghum. Some areas are used for nonirrigated wheat and barley.

This unit is suited to irrigated crops. It is limited mainly by the seasonal high water table and slow permeability in the subsoil. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Irrigation water needs to be applied carefully to prevent the buildup of a high water table during the growing season. Drainage may also be needed. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

If this unit is used for nonirrigated wheat and barley, the main limitation is the moderate available water capacity.

This map unit is in capability units IIw-3 (17), irrigated, and IIIw-3 (17), nonirrigated.

120—Columbia fine sandy loam, clay substratum, frequently flooded, 0 to 2 percent slopes. This very deep, somewhat poorly drained soil is on flood plains. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is light gray and pale brown fine sandy laom about 15 inches thick. The upper 37 inches of the underlying material is stratified, pale brown and light gray fine sandy loam, sand, very fine sandy loam, and silt loam, and the lower part to a depth of 60 inches or more is black and very dark gray clay.

Included in this unit are small areas of Holillipah loamy sand and Shanghai silt loam. Included areas make up about 20 percent of the total acreage.

Permeability of this Columbia soil is moderately rapid to a depth of 52 inches and slow below this depth. Available water capacity is moderate. Effective rooting depth is 40 to 60 inches. A seasonal high water table is at a depth of 36 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is severe. This soil is subject to frequent, long periods of flooding in December through April.

Most areas of this unit are used for irrigated crops, mainly rice and tomatoes. Among the other crops grown are corn, grain sorghum, dry beans, and safflower.

This unit is suited to irrigated crops. It is limited mainly by wetness because of flooding and slow permeability in the subsoil. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Irrigation water needs to be applied carefully to prevent the buildup of a high water table during the growing season. Drainage may also be needed. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

This map unit is in capability unit IVw-2 (17), irrigated and nonirrigated.

121—Columbia fine sandy loam, frequently flooded, 0 to 2 percent slopes. This very deep, somewhat poorly drained soil is on flood plains. It formed in alluvium derived from mixed sources. The native vegetation is mainly trees with a dense brush understory. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is pale brown and brown fine sandy loam about 14 inches thick. The underlying material to a depth of 60 inches or more is stratified, pale brown and light yellowish brown fine sandy loam and light yellowish brown very fine sandy loam. In some areas the surface layer is sandy loam or silt loam.

Included in this unit are small areas of Holillipah and Tisdale soils and Shanghai silt loam. Included areas make up about 20 percent of the total acreage.

Permeability of this Columbia soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 36 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is severe. This soil is subject to frequent, long periods of flooding from December through April.

Most areas of this unit are used for irrigated orchard crops, mainly walnuts. Among the other crops grown are peaches, prunes, pears, and tomatoes. Some areas are used for wildlife habitat.

This unit is suited to irrigated orchards. It is limited mainly by the hazard of flooding. Maintaining areas of trees and brush adjacent to rivers is important for streambank stabilization and erosion control. Maintaining a cover crop in orchards helps to control erosion during periods of flooding. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Tilth and fertility can be improved by returning crop residue to the soil.

This unit is suited to wildlife habitat. It has few limitations. The many different kinds of vegetation in this unit support a variety of wildlife such as raptors, shore birds, waterfowl, upland game birds, and fur-bearing mammals. Management consists primarily of protecting existing vegetation, especially in areas adjacent to rivers.

This map unit is in capability unit IVw-2 (17), irrigated and nonirrigated.

122—Columbia loam, 0 to 2 percent slopes. This very deep, somewhat poorly drained soil is on flood plains. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is light gray and pale brown loam about 25 inches thick. The underlying material to a depth of 60 inches or more is stratified, pale brown, very pale brown, and light gray sandy loam, silt loam, and fine sandy loam.

Included in this unit are small areas of Holillipah loamy sand, Shanghai silt loam, and Byington soils. Included areas make up about 20 percent of the total acreage.

Permeability of this Columbia soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth 36 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is slight. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated crops, mainly walnuts. Among the other crops grown are tomatoes, corn, dry beans, grain sorghum, and safflower. Some areas are used for nonirrigated wheat and barley.

This unit is suited to irrigated crops. It has few limitations. Trickle, furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry. Tilth and fertility can be improved by returning crop residue to the soil.

Nonirrigated areas of this unit are suited to small grain. The unit has few limitations for this use.

This map unit is in capability class I (17), irrigated, and capability unit IIIc-1 (17), nonirrigated.

123—Cometa loam, 0 to 2 percent slopes. This very deep, well drained soil is on terraces. It formed in alluvium derived from mixed sources. Elevation is 30 to 60 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is pale brown and brown loam about 16 inches thick. The subsoil is strong brown clay about 18 inches thick. The underlying material to a depth of 60 inches or more is yellowish red clay loam. In some areas, as a result of leveling, the surface layer is 20 to 35 inches thick.

Included in this unit are small areas of San Joaquin and Snelling soils. Included areas make up about 25 percent of the total acreage.

Permeability of this Cometa soil is very slow. Available water capacity is low. Effective rooting depth is 5 to 20 inches. Runoff is very slow, and the hazard of water erosion is slight.

Most areas of this unit are used for irrigated crops, mainly rice. Some areas are used for irrigated pasture, nonirrigated pasture, and homesites.

This unit is suited to irrigated crops. It is limited mainly by the very slow permeability of the soil. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Because of the very slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production. Tilth and fertility can be improved by returning crop residue to the soil.

If this unit is used for irrigated pasture, the main limitation is the very slow permeability of the soil. Because of this limitation, the length of runs should be adjusted to permit adequate infiltration of water. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Periodic mowing and clipping help to maintain uniform growth, discourage selective grazing, and reduce clumpy growth. Fertilizer is needed to ensure optimum growth of grasses and legumes.

If this unit is used for nonirrigated pasture, the main limitations are the very slow permeability of the soil and a restricted period when adequate green feed is available. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Continuous, intensive, year-round grazing results in a deteriorated plant community that has low value for use as forage. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff. Seeding is a suitable practice if desirable species are absent in the plant community. Fertilizer is needed for optimum growth of grasses and legumes. Fencing and properly locating salt and livestock watering facilities promote uniform distribution of livestock grazing.

If this unit is used for homesite development, the main limitation is the very slow permeability of the soil. Because of this limitation, onsite sewage disposal systems often fail or do not function properly during periods of high rainfall. If the unit is used for septic tank absorption fields, the limitation of very slow permeability can be overcome by increasing the size of the absorption fields. Shrubs and trees adapted to shallow soils are best suited to this unit.

This map unit is in capability unit IVs-3 (17), irrigated and nonirrigated.

124—Conejo loam, 0 to 2 percent slopes. This very deep, well drained soil is on low terraces. It formed in alluvium derived from mixed sources. Elevation is 30 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is brown loam about 7 inches thick. The subsoil is brown loam about 23 inches thick. The underlying material to a depth of 60 inches or more is pale brown loam.

Included in this unit are small areas of Marcum and Tisdale soils. Included areas make up about 25 percent of the total acreage.

Permeability of this Conejo soil is moderate. Available water capacity is high. Effective rooting depth is 60

Most areas of this unit are used for irrigated orchard crops, mainly peaches and prunes. Among the other crops grown are irrigated corn, tomatoes, and melons and nonirrigated wheat and barley. Some areas are used for homesite development.

This unit is suited to irrigated crops and to nonirrigated wheat and barley. It is limited mainly by the depth to siltstone. Where a thin siltstone layer is present at a root-limiting depth and is underlain by more permeable material, excavations of adequate depth should be made for each planting. Furrow, trickle, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry.

If this unit is used for homesite development, the main limitation is the depth to siltstone. In areas where the layer of siltstone is thin and is underlain by more permeable material, septic tank absorption lines should be placed below the siltstone. Because of this restrictive layer, onsite sewage disposal systems often fail or do not function properly during periods of high rainfall. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

This map unit is in capability unit IIIs-8 (17), irrigated and nonirrigated.

127—Conejo-Urban land complex, 0 to 2 percent slopes. This map unit is on low terraces. Elevation is 30 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

This unit is 45 percent Conejo soil and 45 percent Urban land. The components of this unit are so intricately intermingled that it was not practical to map them separarely at the scale used.

Included in this unit are small areas of Gridley soils and a soil that is similar to the Conejo soil but has siltstone at a depth of more than 60 inches. Included areas make up about 10 percent of the total acreage.

The Conejo soil is deep and well drained. It formed in alluvium derived from mixed sources. Typically, the surface layer is brown loam about 11 inches thick. The subsoil is pale brown loam about 31 inches thick over siltstone. Depth to siltstone ranges from 40 to 60 inches. Thickness of the siltstone ranges from 6 inches to many feet.

Permeability of the Conejo soil is moderately slow. Available water capacity is moderate to high. Effective rooting depth is 40 to 60 inches. Runoff is very slow, and the hazard of water erosion is slight.

Urban land consists of areas used as sites for residential and commercial buildings, streets, and other impermeable surfaces.

This unit is used mainly for urban development. It is also used for irrigated orchard and row crops.

If this unit is used for homesite development, the main limitation is the depth to siltstone. In areas where the layer of siltstone is thin and is underlain by more permeable material, septic tank absorption lines should be placed below the siltstone. Because of this restrictive layer, onsite sewage disposal systems often fail or do not function properly during periods of high rainfall. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

This unit is suited to irrigated orchard crops and row crops. It is limited mainly by the depth to siltstone. Where a thin siltstone layer is present at a root-limiting depth and is underlain by more permeable material, excavations of adequate depth should be made for each planting. Furrow, trickle, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Returning crop residue to the soil improves fertility, reduces crusting, and increases the water intake rate. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry.

The Conejo soil is in capability class I (17), irrigated, and capability unit IIIc-1 (17), nonirrigated.

128—Exeter sandy loam, 0 to 2 percent slopes. This moderately deep, well drained soil is on terraces. It formed in alluvium derived from mixed sources, but dominantly from granite. Elevation is 30 to 60 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is pink sandy loam about 9 inches thick. The upper 6 inches of the subsoil is reddish yellow sandy clay loam, and the lower 15 inches is strong brown and brown sandy clay loam. The next layer is a strongly cemented hardpan 20 inches thick. The underlying material to a depth of 60 inches or more is weakly cemented sandy loam. In some areas the surface layer is 5 to 30 inches thick as a result of leveling. Depth to the hardpan ranges from 20 to 40 inches.

Included in this unit are small areas of Cometa, Galt, and San Joaquin soils and a soil that is similar to this Exeter soil but has a hardpan at a depth of less than 20 inches. Included areas make up about 15 percent of the total acreage.

Permeability of this Exeter soil is moderate. Available water capacity is low to moderate. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight.

Most areas of this unit are used for irrigated rice. A few areas are used for irrigated pasture, nonirrigated pasture, and homesites.

This unit is suited to irrigated rice. It has few limitations. Tilth and fertility can be improved by returning crop residue to the soil.

If this unit is used for irrigated pasture, the main limitation is the depth to the hardpan. Only plants that have a shallow rooting depth should be planted. Irrigation water needs to be applied carefully to prevent the buildup of a perched water table. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Periodic mowing and clipping help to maintain uniform growth, discourage selective grazing, and reduce clumpy growth. Fertilizer is needed to ensure optimum growth of grasses and legumes.

If this unit is used for nonirrigated pasture, the main concern is a limited period when adequate green feed is available. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Continuous, intensive, year-round grazing results in a deteriorated plant community that has low value for use as forage. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff. Seeding is a suitable practice if desirable species are absent in the plant community. Fertilizer is needed for optimum growth of grasses and legumes. Fencing and properly locating salt and livestock watering facilities promote uniform distribution of livestock grazing.

If this unit is used for homesite development, the main limitation is the shallow depth to the hardpan. Excavation for building sites is limited by the hardpan. Because of this restrictive layer, onsite sewage disposal systems often fail or do not function properly during periods of high rainfall. If the soil in this unit is used for septic tank absorption fields, the limitation of shallow depth to the hardpan can be overcome by increasing the size of the absorption field. Shrubs and trees adapted to shallow soils are best suited to this unit.

This map unit is in capability unit IIIs-8 (17), irrigated and nonirrigated.

129—Galt clay, 0 to 2 percent slopes. This moderately deep, moderately well drained soil is on basin rims. It formed in alluvium derived from mixed sources. Elevation is 10 to 40 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is grayish brown clay about 10 inches thick. The next 11 inches is brown clay. The next layer is a strongly cemented hardpan 21 inches thick. The underlying material to a depth of 60 inches or more is pale yellow loam. Depth to the hardpan ranges from 20 to 40 inches.

Included in this unit are small areas of Capay, Clear Lake, and Jacktone soils. Included areas make up about 15 percent of the total acreage.

Permeability of this Galt soil is slow. Available water capacity is low to moderate. Effective rooting depth is 20 to 40 inches. Runoff is very slow, and the hazard of water erosion is slight. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated rice. A few areas are used for sugar beets and grain sorghum.

If this unit is used for irrigated crops, the main limitation is the slow permeability of the soil. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Because of the slow permeability of the soil, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production. Tilth and fertility can be improved by returning crop residue to the soil.

This map unit is in capability unit IIIs-5 (17) irrigated and nonirrigated.

130—Galt clay, frequently flooded, 0 to 2 percent slopes. This moderately deep, moderately well drained soil is on basin rims. It formed in alluvium derived from mixed sources. Elevation is 10 to 40 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is grayish brown clay about 10 inches thick. The next 11 inches is brown clay over a strongly cemented hardpan about 21 inches thick. The underlying material to a depth of 60 inches or more is pale yellow loam. Depth to the hardpan ranges from 20 to 40 inches.

Included in this unit are small areas of Capay, Clear Lake, and Jacktone soils. Included areas make up about 15 percent of the total acreage.

Permeability of this Galt soil is slow. Available water capacity is low to moderate. Effective rooting depth is 20 to 40 inches. Runoff is very slow, and the hazard of water erosion is slight. This soil is subject to frequent, brief to long periods of flooding in December through April.

Most areas of this unit are used for irrigated rice. A few areas are used for sugar beets and grain sorghum.

If this unit is used for irrigated crops, the main limitation is the slow permeability of the soil. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Because of the slow permeability of the soil, water should be applied so that it does not stand on the surface and damage the crops.

This practice, however, is not applicable if the soil is used for rice production. Tilth and fertility can be improved by returning crop residue to the soil.

This map unit is in capability unit IVw-5 (17), irrigated and nonirrigated.

131—Garretson Variant loam, 0 to 2 percent slopes. This very deep, well drained soil is on flood plains. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is light brownish gray loam about 15 inches thick. The underlying material to a depth of 60 inches or more is very pale brown loam.

Included in this unit are small areas of Conejo, Liveoak, and Tisdale soils. Included areas make up about 10 percent of the total acreage.

Permeability of this Garretson Variant soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight.

Most areas of this unit are used for irrigated orchard crops, mainly peaches, walnuts, and prunes. Among the other crops grown are irrigated tomatoes, corn, and dry beans. Some areas are used for nonirrigated barley.

This unit is suited to irrigated crops and nonirrigated barley. It has few limitations. Orchard crops are susceptible to lime-induced iron chlorosis. Other nutrients such as phosphorus and zinc may also be unavailable. Overcoming this deficiency requires application of fertilizer in a form that will remain available to the plant. Furrow, trickle, border, corrugation, and sprinkler irrigation systems are suited to this unit. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry.

This unit is in capability class I (17), irrigated, and capability unit IIIc-1 (17), nonirrigated.

132—Gridley clay loam, 0 to 1 percent slopes. This moderately deep, moderately well drained soil is on terraces and basin rims. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is brown clay loam about 19 inches thick. The subsoil is brown and yellowish brown clay about 18 inches thick. Siltstone is at a depth of 37 inches. Depth to siltstone ranges from 20 to 40 inches. Thickness of the siltstone ranges from 6 inches to many feet.

Included in this unit are small areas of Capay, Conejo, Liveoak, Marcum, Oswald, and Tisdale soils. Included areas make up about 20 percent of the total acreage.

Permeability of this Gridley soil is slow. Available water capacity is low to moderate. Effective rooting depth is 20 to 40 inches. Runoff is very slow, and the hazard of water erosion is slight. The shrink-swell potential is high.

Most areas of this unit are used for irrigated crops, mainly rice, prunes, and peaches. Among the other crops grown are irrigated tomatoes, corn, and melons and nonirrigated wheat and barley. Some areas are used for homesite development.

This unit is suited to irrigated crops and nonirrigated wheat and barley. It is limited mainly by the depth to siltstone and the slow permeability of the soil. Because of the restricted rooting depth, trees are subject to windthrow when the soil is wet. Where a thin siltstone layer is present at a root-limiting depth and is underlain by more permeable material, excavations of adequate depth should be made for each planting. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used is generally governed by the crop grown. Because of the slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry. This unit is suited to orchard crops that are adapted to a fine textured subsoil.

If this unit is used for homesite development, the main limitations are the slow permeability of the soil, depth to siltstone, high shrink-swell potential, and low soil strength. If the soil is used for septic tank absorption fields, the limitation of slow permeability can be overcome by increasing the size of the absorption field. Use of sandy backfill for the trench and long absorption lines helps to compensate for the slow permeability. In areas where the layer of siltstone is thin and is underlain by more permeable material, septic tank absorption lines should be placed below the siltstone. Because of this restrictive layer, onsite sewage disposal systems often fail or do not function properly during periods of high rainfall. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems. If buildings are constructed on this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage because of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soil in this unit to support a load.

This map unit is in capability unit IIIs-3 (17), irrigated and nonirrigated.

133—Holillipah loamy sand, 0 to 2 percent slopes. This very deep, somewhat excessively drained soil is on flood plains. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is pale brown loamy sand about 8 inches thick. The underlying material to a depth of 60 inches or more is stratified, light gray loamy sand, pale brown loamy fine sand, and white sand.

Included in this unit are small areas of Columbia and Shanghai silt loam. Also included in old stream channels are small areas of soils that are similar to this Holillipah soil but are gravelly or cobbly throughout. Included areas make up about 20 percent of the total acreage.

Permeability of this Holillipah soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated orchard crops, mainly walnuts, peaches, and prunes. Among the other crops grown are irrigated corn, tomatoes, and dry beans. Some areas are used for irrigated alfalfa.

This unit is suited to irrigated crops. It is limited mainly by rapid permeability and low available water capacity. Because the water intake rate is rapid, sprinkler irrigation is best suited to this unit. Because the soil in this unit is droughty, applications of irrigation water should be light and frequent. If furrow irrigation is used, water should be applied at frequent intervals and runs should be short. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Fertilizer applications should be regulated to prevent contamination of ground water. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion.

This map unit is in capability units IIIs-4 (17), irrigated, and IVs-4 (17), nonirrigated.

134—Holillipah loamy sand, channeled, 0 to 2 percent slopes. This very deep, somewhat excessively drained soil is on flood plains. It formed in alluvium derived from mixed sources. Areas of this unit are cut by channels and have higher depositional bars, which were made during flooding. The native vegetation is mainly trees with a dense brush understory. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is pale brown loamy sand about 8 inches thick. The underlying material to a depth of 60 inches or more is stratified, white sand, light yellowish brown loamy sand, brown fine sandy loam, and pale brown loamy fine sand.

Included in this unit are small areas of Columbia and Shanghai fine sandy loam and small areas of stratified sand and gravel bars in river channels. Included areas make up about 20 percent of the total acreage.

Permeability of this Holillipah soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is severe. This soil is subject to frequent, long periods of flooding in December through April.

This unit is used for wildlife habitat.

This unit is suited to wildlife habitat. It has few limitations. The many different kinds of vegetation on this unit support a variety of wildlife such as raptors, shore birds, waterfowl, upland game birds, and fur-bearing mammals. Management consists primarily of protecting existing vegetation, especially in areas adjacent to rivers.

Channeling and deposition are common along streambanks. Maintaining areas of trees and brush adjacent to rivers is important for streambank stabilization and erosion control.

This map unit is in capability unit IVw-4 (17), nonirrigated.

135—Holillipah loamy sand, frequently flooded, 0 to 2 percent slopes. This very deep, somewhat excessively drained soil is on flood plains. It formed in alluvium derived from mixed sources. The native vegetation is trees with a dense brush understory. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is pale brown loamy sand about 8 inches thick. The underlying material to a depth of 60 inches or more is stratified, white sand, light yellowish brown loamy sand, brown fine sandy loam, and pale brown loamy fine sand.

Included in this unit are small areas of Columbia and Shanghai silt loams and small areas of sand and gravel bars in river channels. Included areas make up about 20 percent of the total acreage.

Permeability of this Holillipah soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is severe. This soil is subject to frequent, long periods of flooding in December through April.

Most areas of this unit are used for irrigated orchard crops, mainly walnuts. Among the other crops grown are prunes, corn, dry beans, safflower, and grain sorghum. Some areas are used for wildlife habitat.

This unit is suited to irrigated orchards. It is limited mainly by the rapid permeability, low available water capacity, and hazard of flooding. Because the water intake rate is rapid, sprinkler irrigation is suited to this unit. Because the soil in this unit is droughty, applications of irrigation water should be light and frequent. If furrow irrigation is used, water should be applied at frequent intervals and runs should be short. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Fertilizer applications should be regulated to prevent contamination of ground water. Maintaining areas of trees and brush adjacent to rivers is important for streambank stabilization and erosion control. Maintaining a cover crop in orchards helps to control erosion during periods of flooding and helps to conserve moisture and maintain tilth.

This unit is suited to wildlife habitat. It has few limitations. The many different kinds of vegetation on this unit support a variety of wildlife such as raptors, shore birds, waterfowl, upland game birds, and fur-bearing mammals. Management consists primarily of protecting existing vegetation, especially in areas adjacent to rivers.

This map unit is in capability unit IVw-4 (17), irrigated and nonirrigated.

136—Holillipah sandy loam, 0 to 2 percent slopes. This very deep, somewhat excessively drained soil is on flood plains. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is pale brown sandy loam about 15 inches thick. The underlying material to a depth of 60 inches or more is stratified, light yellowish brown loamy sand, very pale brown silt loam, and white sand.

Included in this unit are small areas of Columbia and Shanghai soils. Included areas make up about 20 percent of the total acreage.

Permeability of this Holillipah soil is moderately rapid. Available water capacity is low to moderate. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated orchard crops, mainly walnuts and peaches. Among the other crops grown are corn, alfalfa, tomatoes, and dry beans. Some areas are used for nonirrigated wheat and barley.

This unit is suited to irrigated crops. It has few limitations. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. If furrow irrigation is used, water should be applied at frequent intervals and runs should be short. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Fertilizer applications should be regulated to prevent contamination of ground water. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion.

If this unit is used for nonirrigated wheat and barley, the main limitation is the available water capacity.

This map unit is in capability units IIs-1 (17), irrigated, and IIIs-1 (17) nonirrigated.

137—Jacktone clay, 0 to 2 percent slopes. This moderately deep soil is in basins and on basin rims. Under natural conditions this soil is somewhat poorly drained; however, drainage has been improved by the use of open ditches and flood control structures. The soil formed in alluvium derived from mixed sources. Elevation is 10 to 40 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is dark gray clay about 25 inches thick. The next 3 inches is dark gray clay, and the next 7 inches is dark grayish brown clay loam. The next layer is a strongly cemented hardpan 4 inches thick. The underlying material to a depth of 60 inches or more is pale brown, weakly cemented loam. Depth to the hardpan ranges from 20 to 40 inches.

Included in this unit are small areas of Capay, Clear Lake, and Galt soils. Included areas make up about 15 percent of the total acreage.

Permeability of this Jacktone soil is slow. Available water capacity is low to moderate. Effective rooting depth is 20 to 40 inches. Runoff is very slow, and the hazard of water erosion is slight. A perched water table is at a depth of 18 to 36 inches in December through April. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated rice. A few areas are used for sugar beets, tomatoes, corn, and grain sorghum.

If this unit is used for irrigated crops, the main limitation is the slow permeability of the soil. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Because of the slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production. Tilth and fertility can be improved by returning crop residue to the soil.

This map unit is in capability unit IIIw-5 (17), irrigated and nonirrigated.

138—Liveoak sandy clay loam, 0 to 1 percent slopes. This very deep, well drained soil is on low terraces. It formed in alluvium derived from mixed

140—Marcum clay loam, 0 to 2 percent slopes. This very deep, moderately well drained soil is on basin rims. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 16 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is grayish brown clay loam about 9 inches thick. The upper 26 inches of the subsoil is brown clay, and the lower part to a depth of 60 inches or more is light yellowish brown clay loam.

Included in this unit are small areas of Capay silty clay and Galt and Tisdale soils. Included areas make up about 20 percent of the total acreage.

Permeability of this Marcum soil is slow. Available water capacity is high to very high. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated crops, mainly rice. Among the other crops grown are irrigated walnuts, peaches, prunes, tomatoes, and corn and nonirrigated wheat and barley. Some areas are used for irrigated pasture.

This unit is suited to irrigated crops. It is limited mainly by the slow permeability of the soil. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Because of the slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production. Tilth and fertility can be improved by returning crop residue to the soil.

If this unit is used for nonirrigated crops, the main limitation is the slow permeability of the soil. Because of the slow permeability and wetness that results from winter rains, small grain should be planted in raised beds.

If this unit is used for irrigated pasture, the main limitation is the slow permeability of the soil. Because of the slow permeability, the length of runs should be adjusted to permit adequate infiltration of water. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Periodic mowing and clipping help to maintain uniform growth, discourage selective grazing, and reduce clumpy growth. Fertilizer is needed to ensure optimum growth of grasses and legumes.

This map unit is in capability units IIs-3 (17), irrigated, and IIIs-3 (17) nonirrigated.

141—Marcum clay loam, siltstone substratum, 0 to 1 percent slopes. This deep, moderately well drained soil is on low terraces and basin rims. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is brown clay loam about 16 inches thick. The upper 12 inches of the subsoil is dark yellowish brown clay loam, and the lower 12 inches is strong brown clay. The underlying material is light yellowish brown clay loam about 3 inches thick over siltstone. Depth to siltstone ranges from 40 to 60 inches. Thickness of the siltstone ranges from 6 inches to many feet.

Included in this unit are small areas of Conejo, Gridley, Oswald, and Tisdale soils. Included areas make up about 25 percent of the total acreage.

Permeability of this Marcum soil is slow. Available water capacity is moderate to very high. Effective rooting depth is 40 to 60 inches. Runoff is very slow, and the hazard of water erosion is slight. The shrink-swell potential is high.

Most areas of this unit are used for irrigated crops, mainly rice. Among the other crops grown are irrigated tomatoes, corn, peaches, prunes, grain sorghum, safflower, and dry beans and nonirrigated wheat and barley (fig. 2). Some areas are used for homesite development.

This unit is suited to irrigated crops and nonirrigated wheat and barley. It is suited to fruit and nuts that are adapted to a fine textured subsoil. The unit is limited mainly by the slow permeability of the soil and depth to siltstone. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Because of the slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production. Where a thin siltstone layer is present at a root-limiting depth and is underlain by more permeable material, excavations of adequate depth should be made for each planting. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry.

If this unit is used for homesite development, the main limitations are the slow permeability of the soil, depth to siltstone, high shrink-swell potential, and low soil strength. If the soil is used for septic tank absorption fields, the limitation of slow permeability can be overcome by increasing the size of the absorption field. Use of sandy backfill for the trench and long absorption lines helps to compensate for the slow permeability. In areas where the layer of siltstone is thin and is underlain by more permeable material, septic tank absorption lines

Figure 2.—Young peach orchard in an area of Marcum clay loam, siltstone substratum, 0 to 1 percent slopes.

should be placed below the siltstone. Because of this restrictive layer, onsite sewage disposal systems often fail or do not function properly during periods of high rainfall. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems. If buildings are constructed on this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage because of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soil in this unit to support a load.

This map unit is in capability units IIs-3 (17), irrigated, and IIIs-3 (17), nonirrigated.

142—Marcum clay loam, occasionally flooded, 0 to 2 percent slopes. This very deep, moderately well drained soil is on basin rims. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 16 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is grayish brown clay loam about 9 inches thick. The upper 26 inches of the subsoil is brown clay, and the lower part to a depth of 60 inches or more is light yellowish brown clay loam.

Included in this unit are small areas of Capay silty clay and Galt and Tisdale soils. Included areas make up about 20 percent of the total acreage.

Permeability of this Marcum soil is slow. Available water capacity is high to very high. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight. This soil is subject to occasional, brief periods of flooding in December through April.

Most areas of this unit are used for irrigated crops, mainly rice. Some areas are used for corn and pasture.

This unit is suited to irrigated crops. It is limited mainly by the slow permeability of the soil and wetness because of flooding. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Because of the slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production. Field ditches and pipe drops or vegetated outlets are needed to remove excess water. Tilth and fertility can be improved by returning crop residue to the soil.

If this unit is used for irrigated pasture, the main limitation is the slow permeability of the soil and the hazard of flooding. Wetness limits the choice of plants and the period of cutting or grazing and increases the risk of winterkill. Because of the slow permeability of the soil in this unit, the length of runs should be adjusted to permit adequate infiltration of water. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Periodic mowing and clipping help to maintain uniform growth, discourage selective grazing, and reduce clumpy growth. Fertilizer is needed to ensure optimum growth of grasses and legumes.

This map unit is in capability units IIw-2 (17), irrigated, and IIIw-2 (17), nonirrigated.

143—Marcum-Gridley clay loams, 0 to 1 percent slopes. This map unit is on terraces and basin rims. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

This unit is 45 percent Marcum clay loam and 40 percent Gridley clay loam. The components of this map unit are so intricately intermingled that it was not practical to map them separarely at the scale used.

Included in this unit are small areas of Capay, Conejo, Liveoak, Oswald, and Tisdale soils. Included areas make up about 15 percent of the total acreage.

The Marcum soil is deep and moderately well drained. It formed in alluvium derived from mixed sources. Typically, the surface layer is brown clay loam about 16 inches thick. The upper 12 inches of the subsoil is dark yellowish brown clay loam, and the lower 12 inches is strong brown clay. The underlying material is light yellowish brown clay loam 3 inches thick over siltstone. Depth to siltstone ranges from 40 to 60 inches. Thickness of the siltstone ranges from 6 inches to many feet.

Permeability of the Marcum soil is slow. Available water capacity is moderate to very high. Effective rooting depth is 40 to 60 inches. Runoff is very slow, and the hazard of water erosion is slight. The shrink-swell potential is high.

The Gridley soil is moderately deep and moderately well drained. It formed in alluvium derived from mixed sources. Typically, the surface layer is brown clay loam about 19 inches thick. The subsoil is brown and yellowish brown clay about 18 inches thick over siltstone. Depth to siltstone ranges from 20 to 40 inches. Thickness of the siltstone ranges from 6 inches to many feet.

Permeability of the Gridley soil is slow. Available water capacity is low to moderate. Effective rooting depth is 20 to 40 inches. Runoff is very slow, and the hazard of water erosion is slight. The shrink-swell potential is high.

Most areas of this unit are used for irrigated crops, mainly rice. Among the other crops grown are irrigated peaches, prunes, corn, tomatoes, grain sorghum, and safflower and nonirrigated wheat and barley. Some areas are used for homesite development.

This unit is suited to irrigated crops and nonirrigated wheat and barley. It is suited to orchard crops that are adapted to a fine textured subsoil. This unit is limited mainly by the slow permeability of the soils. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Because of the slow permeability of the soils, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soils are used for rice production. Where a thin siltstone layer is present at a root-limiting depth and is underlain by more permeable material, excavations of adequate depth should be made for each planting. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry.

If this unit is used for homesite development, the main limitations are the slow permeability of the soils, depth to siltstone, high shrink-swell potential, and low soil strength. If the soils in this unit are used for septic tank absorption fields, the limitation of slow permeability can be overcome by increasing the size of the absorption field. Use of sandy backfill for the trench and long absorption lines helps to compensate for the slow permeability. In areas where the layer of siltstone is thin and is underlain by more permeable material, septic tank absorption lines should be placed below the siltstone. Because of this restrictive layer, onsite sewage disposal systems often fail or do not function properly during periods of high rainfall. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems. If buildings are constructed on this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage because of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soils in this unit to support a load.

This map unit is in capability unit IIIs-3 (17), irrigated and nonirrigated.

144—Nueva loam, 0 to 1 percent slopes. This very deep, somewhat poorly drained soil is on flood plains. It formed in alluvium derived from mixed sources. Elevation is 20 to 50 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is brown loam about 17 inches thick. The upper 25 inches of the underlying material is pale brown, stratified loam and silt loam, and the lower part to a depth of 60 inches or more is dark grayish brown clay loam. A dark grayish brown clay loam is not present in some areas.

Included in this unit are small areas of Columbia and Shanghai soils. Included areas make up about 15 percent of the total acreage.

Permeability of this Nueva soil is moderate to a depth of 42 inches and moderately slow below this depth. Available water capacity is high. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 48 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is slight. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated crops, mainly walnuts. Among the other crops grown are peaches, prunes, rice, tomatoes, corn, sugar beets, dry beans, safflower, and grain sorghum. Some areas are used for nonirrigated wheat and barley and for homesite development.

This unit is suited to irrigated crops (fig. 3). It has few limitations. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry.

Nonirrigated areas of this unit are suited to small grain. These areas have few limitations for this use.

If this unit is used for homesite development, the main limitation is the seasonal high water table. The installation and operation of septic tank absorption fields are limited by the water table. Septic tank absorption fields do not function properly during periods of high rainfall because of wetness. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

This map unit is in capability class I, irrigated, and capability unit IIIc-1 (17), nonirrigated.

145—Nueva loam, occasionally flooded, 0 to 1 percent slopes. This very deep, somewhat poorly drained soil is on flood plains. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is grayish brown loam about 22 inches thick. The underlying material to a depth of 60 inches or more is stratified, pale brown and brown loam.

Included in this unit are small areas of Snelling soils, a soil that is similar to this Nueva soil but has a surface layer less than 20 inches thick, and a soil that is similar to this Nueva soil but has a clay loam subsoil. Included areas make up about 15 percent of the total acreage.

Permeability of this Nueva soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 48 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is slight. This soil is subject to occasional, brief periods of flooding in December through April.

Most areas of this unit are used for irrigated crops, mainly rice. A few areas are used for nonirrigated hay and irrigated pasture.

This unit is suited to irrigated crops. It is limited mainly by wetness because of flooding. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Field ditches and pipe drops or other outlets are needed to remove excess water. Tilth and fertility can be improved by returning crop residue to the soil.

If this unit is used for nonirrigated hay, the main limitation is the hazard of flooding. Excess water on the surface can be removed by properly leveling and using field ditches.

If this unit is used for irrigated pasture, the main limitation is the hazard of flooding. Excess water on the surface can be removed by properly leveling and using field ditches. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff.

This map unit is in capability units IIw-2 (17), irrigated, and IIIw-2 (17), nonirrigated.

146—Nueva loam, wet, 0 to 1 percent slopes. This very deep, somewhat poorly drained soil is on flood plains. It formed in alluvium derived from mixed sources. Elevation is 20 to 50 feet. The average annual precipitation is 14 to 17 inches, the average annual air and andesitic lahar. Typically, 3 to 15 percent of the surface is covered with stones. The surface layer is brown and light brownish gray stony sandy loam about 8 inches thick. The subsoil is light brownish gray and pale brown gravelly sandy loam about 23 inches thick. Hard andesitic lahar is at a depth of 31 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Palls soil is moderately rapid. Available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate to high.

The Stohlman soil is shallow and well drained. It formed in residuum derived dominantly from andesite and andesitic lahar. Typically, 3 to 15 percent of the surface is covered with stones. The surface layer is light brownish gray and pale brown stony sandy loam about 7 inches thick. The subsoil is pale brown gravelly sandy loam about 9 inches thick. Hard andesitic lahar is at a depth of 16 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Stohlman soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 10 to 20 inches. Runoff is rapid, and the hazard of water erosion is moderate to high.

This unit is used as woodland and livestock grazing.

This unit supports stands of blue oak. On the Palls soil, volumes of approximately 93 cords per acre of blue oak with an average diameter at breast height of about 12 inches have been measured. On the Stohlman soil, volumes of approximately 12.5 cords per acre of blue oak with an average diameter at breast height of about 9 inches have been measured. Stones on the surface limit harvesting of the blue oak. Care is needed in harvesting to allow for stump sprouting for regeneration of the oak and to minimize soil erosion when the plant cover is disturbed.

If this unit is used for forage production, it has few limitations. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Livestock grazing should be managed to protect the unit from erosion. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. The tree overstory generally is open; therefore, light reaches the ground and encourages the growth of a good understory. The present understory vegetation on this unit is mainly soft chess, wild oat, fescue, and filaree.

This map unit is in capability subclass VIs (18), nonirrigated.

158—San Joaquin sandy loam, 0 to 2 percent slopes. This moderately deep, well drained soil is on terraces. It formed in alluvium derived from mixed sources, dominantly granite. Elevation is 30 to 60 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is brown sandy loam about 11 inches thick. The upper 5 inches of the subsoil is yellowish red sandy loam, and the lower 11 inches is yellowish red and brown clay. The next layer is a strongly cemented hardpan about 4 inches thick. The upper 8 inches of the underlying material is yellowish red sandy clay loam, and the lower part to a depth of 60 inches or more is yellowish red coarse sandy loam. Depth to the hardpan ranges from 20 to 40 inches. In some areas, as a result of leveling, the surface layer is 5 to 30 inches thick. In some areas the surface layer is loam.

Included in this unit are small areas of Cometa and Snelling soils. Also included are small areas of a soil that is similar to this San Joaquin soil but has had the surface layer removed as a result of leveling. Included areas make up about 25 percent of the total acreage.

Permeability of this San Joaquin soil is moderate to a depth of 16 inches and very slow below this depth. Available water capacity is very low to low. Effective rooting depth is 10 to 35 inches. Runoff is very slow, and the hazard of water erosion is slight.

Most areas of this unit are used for irrigated crops, mainly rice. Some areas are used for irrigated pasture, nonirrigated pasture, and homesites.

This unit is suited to irrigated crops. It is limited mainly by the very slow permeability of the soil. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Because of the very slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production. Tilth and fertility can be improved by returning crop residue to the soil.

If this unit is used for irrigated pasture, the main limitations are the very slow permeability of the soil and depth to the hardpan. Only plants that have a shallow rooting depth should be planted. Irrigation water needs to be applied carefully to prevent the buildup of a perched water table. Because of the very slow permeability of the soil in this unit, the length of runs should be adjusted to permit adequate infiltration of water. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Periodic mowing and clipping help to maintain uniform growth, discourage selective grazing, and reduce clumpy growth. Fertilizer is needed to ensure optimum growth of grasses and legumes.

If this unit is used for nonirrigated pasture, the main limitations are the very slow permeability of the soil and a limited period when adequate green feed is available.

Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Continuous, intensive, year-round grazing results in a deteriorated plant community that has low value for use as forage. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff. Seeding is a suitable practice if desirable species are absent in the plant community. Fertilizer is needed for optimum growth of grasses and legumes. Fencing and properly locating salt and livestock watering facilities promote uniform distribution of livestock grazing.

If this unit is used for homesite development, the main limitations are the very slow permeability of the soil and depth to the hardpan. Excavation for building sites is limited by the hardpan. Because of this restrictive layer, onsite sewage disposal systems often fail or do not function properly during periods of high rainfall. If this unit is used for septic tank absorption fields, the limitation of very slow permeability can be overcome by increasing the size of the absorption fields. Shrubs and trees adapted to shallow soils are best suited to this unit.

This map unit is in capability unit IVs-3 (17), irrigated and nonirrigated.

159—San Joaquin sandy loam, occasionally flooded, 0 to 2 percent slopes. This moderately deep, well drained soil is on terraces. It formed in alluvium derived from mixed sources, dominantly granite. Elevation is 30 to 60 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is brown sandy loam about 11 inches thick. The upper 5 inches of the subsoil is yellowish red sandy loam, and the lower 11 inches is yellowish red and brown clay. The next layer is a strongly cemented hardpan about 4 inches thick. The upper 8 inches of the underlying material is yellowish red sandy clay loam, and the lower part to a depth of 60 inches or more is yellowish red coarse sandy loam. Depth to the hardpan ranges from 20 to 40 inches. In some areas, as a result of leveling, the surface layer is 5 to 30 inches thick. In some areas the surface layer is loam.

Included in this unit are small areas of Cometa and Snelling soils. Included areas make up about 25 percent of the total acreage.

Permeability of this San Joaquin soil is moderate to a depth of 16 inches and very slow below this depth. Available water capacity is very low to low. Effective rooting depth is 10 to 35 inches. Runoff is very slow, and the hazard of water erosion is slight. This soil is subject to occasional, brief periods of flooding in December through April.

Most areas of this unit are used for irrigated crops, mainly rice. Some areas are used for irrigated pasture.

This unit is suited to irrigated crops. It is limited mainly by wetness because of flooding and the very slow permeability of the soil. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Because of the very slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production. Field ditches and pipe drops or other outlets are needed to remove excess water from the surface. Tilth and fertility can be improved by returning crop residue to the soil.

If this unit is used for irrigated pasture, the main limitations are the very slow permeability of the soil and depth to the hardpan. Only plants that have a shallow rooting depth should be planted. Irrigation water needs to be applied carefully to prevent the buildup of a perched water table. Because of the very slow permeability of the soil in this unit, the length of runs should be adjusted to permit adequate infiltration of water. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Periodic mowing and clipping help to maintain uniform growth, discourage selective grazing, and reduce clumpy growth. Fertilizer is needed to ensure optimum growth of grasses and legumes.

This map unit is in capability unit IVw-2 (17), irrigated and nonirrigated.

160—San Joaquin-Arents-Durochrepts complex, 0 to 1 percent slopes. This map unit is on terraces. It has been altered by land leveling. Elevation is 20 to 50 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

This unit is 30 percent San Joaquin sandy loam, 25 percent Arents, and 25 percent Durochrepts. Some areas of San Joaquin soils that originally were on convex ridgetops were cut and are now Durochrepts. Areas of San Joaquin soils in concave swales were buried and are now Arents. The components of this unit are so intricately intermingled that it was not practical to map them separarely at the scale used.

Included in this unit are small areas of Cometa, Galt, and Snelling soils and a soil that is similar to the San Joaquin soil but has had the surface layer removed by leveling. Included areas make up about 20 percent of the total acreage.

The San Joaquin soil is moderately deep and well drained. It formed in alluvium derived from mixed sources, dominantly granite. Typically, the surface layer is brown sandy loam about 11 inches thick. The upper 5 inches of the subsoil is yellowish red sandy loam, and the lower 11 inches is yellowish red and brown clay. The next layer is a strongly cemented hardpan about 4 inches thick. The upper 8 inches of the underlying material is yellowish red sandy clay loam, and the lower part to a depth of 60 inches or more is yellowish red coarse sandy loam. Depth to the hardpan ranges from 20 to 40 inches. In some areas the surface layer is 5 to 30 inches thick as a result of leveling.

Permeability of the San Joaquin soil is moderate to a depth of 16 inches and very slow below this depth. Available water capacity is very low to low. Effective rooting depth is 10 to 35 inches. Runoff is very slow, and the hazard of water erosion is slight.

The Arents, to a depth of 48 inches, are light yellowish brown and strong brown sandy loam and sandy clay loam that are 10 to 20 percent clay fragments and 10 to 20 percent hardpan fragments. Below this is a buried surface layer of brown sandy loam 8 inches thick. The next layer to a depth of 60 inches or more is light yellowish brown clay. Depth to the buried soil ranges from 20 to 60 inches. Depth to the hardpan ranges from 40 to 60 inches or more.

Permeability of the Arents is slow to rapid. Available water capacity is low to high. Effective rooting depth is 30 to 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight.

The Durochrepts, to a depth of 16 inches, are light yellowish brown and very pale brown sandy loam and sandy clay loam that are 20 to 60 percent hardpan fragments and 5 to 10 percent clay fragments. A strongly cemented hardpan is at a depth of 16 inches. Depth to the hardpan ranges from 5 to 20 inches.

Permeability of the Durochrepts is moderately slow to rapid. Available water capacity is very low to low. Effective rooting depth is 5 to 20 inches. Runoff is very slow, and the hazard of water erosion is slight.

This map unit is used for irrigated rice.

This unit is suited to irrigated rice. It is limited mainly by the restricted rooting depth of the Durochrepts. Ripping and shattering the hardpan increases the effective rooting depth. Tilth and fertility can be improved by returning crop residue to the soil.

This map unit is in capability unit IVs-3 (17), irrigated and nonirrigated.

161—Shanghai fine sandy loam, channeled, 0 to 2 percent slopes. This very deep, somewhat poorly drained soil is on flood plains. It formed in alluvium derived from mixed sources. Areas of this unit are cut by channels and have higher depositional bars that were laid down during flooding. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is light yellowish brown fine sandy loam about 15 inches thick. The underlying material to a depth of 60 inches or more is pale brown silt loam.

Included in this unit are small areas of Columbia and Holillipah soils. Included areas make up about 15 percent of the total acreage.

Permeability of this Shanghai soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 36 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is moderate. This soil is subject to frequent, long periods of flooding in December through April.

Most areas of this unit are used for irrigated orchard crops, mainly peaches and prunes. Among the other crops grown are corn, tomatoes, safflower, and grain sorghum.

This unit is suited to irrigated orchard crops. It is limited mainly by the hazard of flooding. Sprinkler irrigation is the most suitable method of applying water. Use of this method permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. Maintaining a cover crop in orchards helps to control erosion during periods of flooding.

If this unit is used for irrigated row crops, it is limited mainly by wetness because of flooding. Field ditches and pipe drops or other outlets are needed to remove excess surface water. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry.

This map unit is in capability unit IVw-2 (17), irrigated and nonirrigated.

162—Shanghai silt loam, 0 to 2 percent slopes. This very deep, somewhat poorly drained soil is on flood plains. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is light yellowish brown silt loam about 9 inches thick. The underlying material to a depth of 60 inches or more is stratified, light yellowish brown and very pale brown silt loam and very pale brown silty clay loam.

Included in this unit are small areas of Columbia, Holillipah, and Shanghai fine sandy loam. Included areas make up about 10 percent of the total acreage.

Permeability of this Shanghai soil is moderate. Available water capacity is high to very high. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 36 to 60 inches in December through April. Runoff is slow, and the hazard of water erosion is moderate. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated orchard crops, mainly peaches. Among the other crops grown are walnuts, prunes, tomatoes, corn, and rice. Some areas are used for recreation.

This unit is suited to irrigated orchard crops. It has few limitations. Furrow, trickle, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry.

This unit is suited to recreational development. It has few limitations. Erosion and sedimentation can be controlled and the beauty of the area enhanced by maintaining adequate plant cover. Plant cover can be maintained by limiting traffic.

This map unit is in capability class I (17), irrigated, and capability unit IIIc-1 (17), nonirrigated.

163—Shanghai silt loam, clay substratum, 0 to 2 percent slopes. This very deep, somewhat poorly drained soil is on flood plains. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is yellowish brown silt loam about 12 inches thick. The upper 29 inches of the underlying material is pale brown silt loam, and the lower part to a depth of 60 inches or more is black and dark gray clay. In some areas the surface layer is fine sandy loam.

Included in this unit are small areas of Conejo, Columbia, and Holillipah soils. Included areas make up about 10 percent of the total acreage.

Permeability of this Shanghai soil is moderate to a depth of 41 inches and slow below this depth. Available water capacity is high to very high. Effective rooting depth is 40 to 60 inches. A seasonal high water table is at a depth of 48 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is slight. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated crops, mainly tomatoes, corn, and rice. Among the other crops grown are peaches, walnuts, and wheat.

This unit is suited to irrigated row and orchard crops. It is limited by the seasonal high water table. Furrow, trickle, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Irrigation water needs to be applied carefully to prevent the buildup of a high water table during the growing season. Drainage may also be needed. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry.

This map unit is in capability units IIs-3 (17), irrigated, and IIIs-3 (17), nonirrigated.

164—Shanghai silt loam, clay substratum, frequently flooded, 0 to 2 percent slopes. This very deep, somewhat poorly drained soil is on flood plains. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is yellowish brown silt loam about 12 inches thick. The upper 29 inches of the underlying material is pale brown silt loam, and the lower part to a depth of 60 inches or more is black and dark gray clay. In some areas the surface layer is fine sandy loam.

Included in this unit are small areas of Columbia and Shanghai fine sandy loam. Included areas make up about 10 percent of the total acreage.

Permeability of the Shanghai soil is moderate to a depth of 41 inches and slow below this depth. Available water capacity is high to very high. Effective rooting depth is 40 to 60 inches. A seasonal high water table is at a depth of 48 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is moderate. This soil is subject to frequent, long periods of flooding in December through April.

Most areas of this unit are used for irrigated crops, mainly rice. Among the other crops grown are corn, tomatoes, dry beans, grain sorghum, and safflower. Some areas are used for irrigated pears and prunes.

This unit is suited to irrigated crops. It is limited mainly by the seasonal high water table, hazard of flooding, and wetness because of flooding. Orchard crops, that tolerate wetness such as prunes and pears, are suited to this unit. Maintaining a cover crop in orchards helps to control erosion during periods of flooding. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Irrigation water needs to be applied carefully to prevent the buildup of a high water table during the growing season. Drainage may also be needed. Field ditches and pipe drops or other outlets are needed to remove excess surface water. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry.

This map unit is in capability unit IVw-2 (17), irrigated and nonirrigated.

165—Shanghai silt loam, frequently flooded, 0 to 2 percent slopes. This very deep, somewhat poorly drained soil is on flood plains. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is very pale brown silt loam about 11 inches thick. The underlying material to a depth of 60 inches or more is very pale brown and pale brown silt loam. In some areas the surface layer is fine sandy loam or loamy sand.

Included in this unit are small areas of Columbia and Holillipah soils. Included areas make up about 10 percent of the total acreage.

Permeability of this Shanghai soil is moderate. Available water capacity is high to very high. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 36 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is moderate. This soil is subject to frequent, long periods of flooding in December through April.

Most areas of this unit are used for irrigated orchard crops, mainly peaches, prunes, and pears. Among the other crops grown are corn, tomatoes, dry beans, grain sorghum, and safflower. Some areas are used for recreation.

This unit is suited to irrigated crops. It is limited mainly by the hazard of flooding. Maintaining a cover crop in orchards helps to control erosion during periods of flooding. Field ditches and pipe drops or other outlets are needed to remove excess surface water. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry.

This unit is suited to recreational development. It is limited mainly by the hazards of flooding and soil blowing. Erosion and sedimentation can be controlled and the esthetic value of the area enhanced by maintaining adequate plant cover. Plant cover can be maintained by limiting traffic.

This map unit is in capability unit IVw-2 (17), irrigated and nonirrigated.

166—Shanghai silt loam, wet, 0 to 2 percent slopes. This very deep, somewhat poorly drained soil is on flood plains. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is light yellowish brown silt loam about 8 inches thick. The underlying material to a depth of 60 inches or more is stratified, light yellowish brown and very pale brown silt loam and very fine sandy loam and very pale brown silty clay loam.

Included in this unit are small areas of Columbia and Shanghai fine sandy loam. Included areas make up about 10 percent of the total acreage.

Permeability of this Shanghai soil is moderate. Available water capacity is high to very high. Effective rooting depth is 60 inches or more. A water table is at a depth of 30 to 60 inches in December through April and at a depth of 48 to 60 inches in May through November. Runoff is very slow, and the hazard of water erosion is moderate. This soil is subject to frequent, long periods of flooding from December through April.

This unit is used for irrigated orchard crops, mainly prunes and pears.

This unit is suited to orchard crops. It is limited mainly by the hazard of flooding and the high water table. Orchard crops that are adapted to wetness, such as prunes and pears, are suited to this unit. Maintaining a cover crop in orchards helps to control erosion during periods of flooding. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry.

This map unit is in capability unit IVw-2 (17), irrigated and nonirrigated.

167—Shanghai silty clay loam, 0 to 2 percent slopes. This very deep, somewhat poorly drained soil is on flood plains. It formed in alluvium derived from mixed sources. Elevation is 20 to 50 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is light brownish gray silty clay loam about 13 inches thick. The upper 25 inches of the underlying material is light brownish gray silty clay loam, and the lower part to a depth of 60 inches or more is light brownish gray fine sandy loam. In some areas the soil is silt loam throughout.

Included in this unit are small areas of Columbia and Holillipah soils and a soil that is similar to this Shanghai soil but has underlying material of clay. Included areas make up about 10 percent of the total acreage.

Permeability of this Shanghai soil is moderately slow. Available water capacity is very high. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 36 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is slight. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated crops, mainly walnuts and tomatoes. Among the other crops grown are peaches, prunes, rice, corn, grain sorghum, safflower, dry beans, and sugar beets. Some areas are used for nonirrigated wheat and barley.

This unit is suited to irrigated crops and nonirrigated wheat and barley. It has few limitations. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry.

This map unit is in class I (17), irrigated, and capability unit IIIc-1 (17), nonirrigated.

168—Shanghai Variant loamy sand, 0 to 1 percent slopes. This very deep, somewhat poorly drained soil is on flood plains. It formed in alluvium derived from mixed sources. Elevation is 20 to 50 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is pale brown loamy sand about 18 inches thick. The upper 11 inches of the underlying material is light brownish gray silt loam, the next 23 inches is dark gray silty clay loam, and the lower part to a depth of 60 inches or more is dark grayish brown silty clay loam.

Included in this unit are small areas of Columbia, Nueva, and Shanghai soils. Also included are small areas of soils that are similar to this Shanghai Variant soil but have underlying material of loam. Included areas make up about 15 percent of the total acreage.

Permeability of this Shanghai Variant soil is rapid to a depth of 18 inches and moderately slow below this depth. Available water capacity is high. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 36 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is slight. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated crops, mainly walnuts. Among the other crops grown are corn and dry beans.

This unit is suited to irrigated crops. It limited mainly by the moderately rapid permeability of the surface layer. Sprinkler, trickle, and furrow irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Irrigation water needs to be applied carefully to prevent the buildup of a water table during the growing season. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry.

This map unit is in capability units IIs-4 (17), irrigated, and IVs-4 (17), nonirrigated.

169—Snelling loam, 0 to 2 percent slopes. This very deep, well drained soil is on stream terraces. It formed in alluvium derived dominantly from granitic sources. Elevation is 45 to 70 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is brown loam about 3 inches thick. The upper 16 inches of the subsoil is strong brown loam, and the lower 32 inches is reddish brown sandy clay loam and loam. The underlying material to a depth of 60 inches or more is yellowish red sandy loam.

Included in this unit are small areas of Columbia, Cometa, and San Joaquin soils. Included areas make up about 20 percent of the total acreage.

Permeability of this Snelling soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

Most areas of this unit are used for irrigated orchard crops, mainly walnuts and peaches. Among the other crops grown are irrigated prunes and rice and nonirrigated wheat and barley. Some areas are used for irrigated pasture.

This unit is suited to irrigated crops. It has few limitations. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. This practice, however, is not applicable if the soil is used for rice production.

This unit is suited to irrigated pasture. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Periodic mowing and clipping help to maintain uniform growth, discourage selective grazing, and reduce clumpy growth. Fertilizer is needed to ensure optimum growth of grasses and legumes.

If this unit is used for nonirrigated crops, the main limitation is droughtiness.

This map unit is in capability class I (17), irrigated, and capability unit IIIc-1, nonirrigated.

170—Snelling loam, occasionally flooded, 0 to 2 percent slopes. This very deep, well drained soil is on stream terraces. It formed in alluvium derived dominantly from granitic sources. Elevation is 45 to 70 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is brown loam about 3 inches thick. The upper 16 inches of the subsoil is strong brown loam, and the lower 32 inches is reddish brown sandy clay loam and loam. The underlying material to a depth of 60 inches or more is yellowish red sandy loam.

Included in this unit are small areas of Columbia, Cometa, and San Joaquin soils. Included areas make up about 20 percent of the total acreage.

Permeability of this Snelling soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. This soil is subject to occasional, brief periods of flooding in November through April.

Most areas of this unit are used for irrigated crops, mainly rice.

This unit is suited to irrigated crops. It is limited mainly by wetness because of flooding. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Field ditches and pipe drops or other outlets are needed to remove excess water from the surface. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. This practice, however, is not applicable if the soil is used for rice production.

This map unit is in capability units IIw-2 (17), irrigated, and IIIw-2 (17), nonirrigated.

171—Stohlman-Palls stony sandy loams, 30 to 50 percent slopes. This map unit is on hills. The native vegetation is mainly annual grasses and forbs. Elevation is 75 to 1,500 feet. The average annual precipitation is 16 to 18 inches, the average annual air temperature is 60 to 62 degrees F, and the average frost-free period is 250 to 270 days.

This unit is 40 percent Stohlman stony sandy loam and 35 percent Palls stony sandy loam. The Stohlman soil is on convex ridgetops, and the Palls soil is on concave side slopes. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Ocraig very stony sandy loam and Rock outcrop. Also included are small areas of soils that are similar to the Palls soil but have bedrock at a depth of 40 to 60 inches. Included areas make up about 25 percent of the total acreage.

The Stohlman soil is shallow and well drained. It formed in residuum derived dominantly from andesite and andesitic lahar. Typically, 3 to 15 percent of the surface is covered with stones. The surface layer is light brownish gray and pale brown stony sandy loam about 7 inches thick. The subsoil is pale brown gravelly sandy loam about 9 inches thick. Hard andesitic rock is at a depth of 16 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Stohlman soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 10 to 20 inches. Runoff is rapid, and the hazard of water erosion is high.

The Palls soil is moderately deep and well drained. It formed in residuum derived dominantly from andesite and andesitic lahar. Typically, 3 to 15 percent of the surface is covered with stones. The surface layer is brown and light grayish brown stony sandy loam about 8 inches thick. The subsoil is light brownish gray and pale brown gravelly sandy loam about 23 inches thick. Hard extrusive igneous rock is at a depth of 31 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Palls soil is moderately rapid. Available water capacity is low to very low. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as rangeland.

If this unit is used as rangeland, the main limitation is slope. Steepness of slope limits access by livestock and results in overgrazing of the less sloping areas. Proper placement of livestock watering facilities and salt improves distribution of livestock. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Livestock grazing should be managed to protect the unit from erosion. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. The present vegetation on this unit is mainly soft chess, wild oat, fescue, and filaree.

This map unit is in capability subclass VIs (18), nonirrigated.

172—Stohlman-Palls stony sandy loams, cool, 30 to 50 percent slopes. This map unit is on hills with north, northeast, and northwest aspects. The native vegetation is mainly hardwood trees with an understory of annual grasses and forbs. Elevation is 75 to 1,500 feet. The average annual precipitation is 17 to 19 inches the average annual air temperature is 58 to 60 degrees F, and the average frost-free period is 250 to 270 days.

This unit is 40 percent Stohlman stony sandy loam and 35 percent Palls stony sandy loam. The Stohlman soil is on convex ridgetops, and the Palls soil is on concave side slopes. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Ocraig very stony sandy loam and Rock outcrop. Also included are small areas of soils that are similar to the Palls soil but have bedrock at a depth of 40 to 60 inches. Included areas make up about 25 percent of the total acreage.

The Stohlman soil is shallow and well drained. It formed in residuum derived dominantly from andesite and andesitic lahar. Typically, 3 to 15 percent of the surface is covered with stones. The surface layer is light brownish gray and pale brown stony sandy loam about 7 inches thick. The subsoil is pale brown gravelly sandy loam about 9 inches thick. Hard andesitic lahar is at a depth of 16 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Stohlman soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 10 to 20 inches. Runoff is rapid, and the hazard of water erosion is moderate to high.

The Palls soil is moderately deep and well drained. It formed in residuum derived dominantly from extrusive igneous rock. Typically, 3 to 15 percent of the surface is covered with stones. The surface layer is brown and light grayish brown stony sandy loam about 8 inches thick. The subsoil is light brownish gray and pale brown gravelly sandy loam about 23 inches thick. Hard extrusive rock is at a depth of 31 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Palls soil is moderately rapid. Available water capacity is low to very low. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is moderate to high.

This unit is used as woodland and livestock grazing.

This unit supports stands of blue oak. On the Palls soil, volumes of approximately 93 cords per acre of blue oak with an average diameter at breast height of about 12 inches have been measured. On the Stohlman soil, volumes of approximately 12.5 cords per acre of blue oak with an average diameter at breast height of about 9 inches have been measured. Stones on the surface and slope limit harvesting of the blue oak. Care is needed in harvesting to allow for stump sprouting for regeneration of the oak and to minimize soil erosion when the plant cover is disturbed.

If this unit is used for livestock grazing, the main limitation is slope. Steepness of slope limits access by livestock and results in overgrazing of the less sloping areas. Proper placement of livestock watering facilities and salt improve distribution of livestock. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Livestock grazing should be managed to protect the unit from erosion. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. The tree overstory generally is open; therefore, light reaches the ground and encourages the growth of a good understory. The present understory vegetation on this unit is mainly soft chess, wild oat, fescue, and filaree.

This map unit is in capability subclass VIs (18), nonirrigated.

173—Subaco clay, 0 to 2 percent slopes. This moderately deep soil is in basins. Under natural conditions this soil is poorly drained; however, drainage has been improved by the use of open ditches and flood control structures. The soil formed in alluvium derived from mixed sources. Elevation is 20 to 50 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is dark gray clay about 13 inches thick. The underlying material is gray clay about 13 inches thick over siltstone. Depth to siltstone ranges from 20 to 40 inches.

Included in this unit are small areas of Capay soils, Clear Lake clay, and Oswald soils. Included areas make up about 20 percent of the total acreage.

Permeability of this Subaco soil is slow. Available water capacity is low to moderate. Effective rooting depth is 20 to 40 inches. A perched water table is at a depth of 18 to 36 inches in December through April. Runoff is very slow, and the hazard of water erosion is slight. The shrink-swell potential is high. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated crops, mainly rice. Among the other crops grown are tomatoes, dry beans, sugar beets, grain sorghum, corn, and safflower. Some areas are used for nonirrigated wheat and barley.

This unit is suited to irrigated crops. It is limited mainly by the slow permeability of the soil. Furrow, border, and corrugation irrigation systems are suited to this unit. Sprinkler irrigation can be used, but water needs to be applied slowly to minimize runoff. The method used generally is governed by the crop grown. Because of the slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production. Tilth and fertility can be improved by returning crop residue to the soil.

Nonirrigated areas of this unit are suited to small grain. These areas are limited mainly by the slow permeability of the soil. Because of this slow permeability and wetness that results from winter rains, small grain should be planted in raised beds.

This map unit is in capability unit IIIw-5 (17), irrigated and nonirrigated.

174—Tisdale clay loam, 0 to 2 percent slopes. This moderately deep, well drained soil is on low terraces. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is brown clay loam about 11 inches thick. The subsoil is pale brown and light yellowish brown clay loam about 20 inches thick over siltstone. Depth to siltstone ranges from 20 to 40 inches. Thickness of the siltstone ranges from 6 inches to many feet. In some areas the soil is loam throughout.

Included in this unit are small areas of Conejo, Gridley, Liveoak, and Oswald soils. Also included are small areas of a soil that is similar to this Tisdale soil but has a hardpan 0.5 to 2.0 inches thick over the siltstone. Included areas make up about 25 percent of the total acreage.

Permeability of this Tisdale soil is moderately slow. Available water capacity is low to moderate. Effective rooting depth is 20 to 40 inches. Runoff is very slow, and the hazard of water erosion is slight.

Most areas of this unit are used for irrigated orchard crops, mainly prunes and peaches. Among the other crops grown are rice, corn, tomatoes, and melons. Some areas are used for homesite development.

This unit is suited to irrigated crops. It is limited mainly by the restricted rooting depth. Because of this limitation, trees are subject to windthrow when the soil is wet. Where a thin siltstone layer is present at a root-limiting depth and is underlain by more permeable material, excavations of adequate depth should be made for each planting. Furrow, trickle, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry.

If this unit is used for homesite development, the main limitation is the depth to siltstone. In areas where the layer of siltstone is thin and is underlain by more permeable material, septic tank absorption lines should be placed below the siltstone. Because of this restrictive layer, onsite sewage disposal systems often fail or do not function properly during periods of high rainfall. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

This map unit is in capability unit IIIs-8 (17), irrigated and nonirrigated.

175—Yuvas loam, 0 to 2 percent slopes. This moderately deep, moderately well drained soil is on low terraces and basin rims. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is light yellowish brown and pale brown loam about 16 inches thick. The subsoil is pink clay about 8 inches thick. The next layer is a strongly cemented hardpan about 14 inches thick. Siltstone is at a depth of 38 inches. Depth to the hardpan ranges from 20 to 40 inches.

Included in this unit are small areas of Conejo, Gridley, Oswald, and Tisdale soils. Included areas make up about 15 percent of the total acreage.

Permeability of this Yuvas soil is moderate to a depth of 16 inches and very slow below this depth. Available water capacity is low. Effective rooting depth is 14 to 28 inches. For insignificant periods of time after intense rainstorms in December through April, there is a perched water table at a depth of 18 to 36 inches. Runoff is very slow, and the hazard of water erosion is slight. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated crops, mainly rice. Among the other crops grown are corn and prunes.

This unit is suited to irrigated crops. It is limited mainly by the very slow permeability of the soil. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Because of the very slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production. Tilth and fertility can be improved by returning crop residue to the soil.

If this unit is used for irrigated prunes, the main limitation is the restricted rooting depth. Because of this limitation, trees are subject to windthrow when the soil is wet.

This map unit is in capability unit IVs-3 (17), irrigated and nonirrigated.

176—Yuvas loam, frequently flooded, 0 to 2 percent slopes. This moderately deep, moderately well drained soil is on terraces and basin rims. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is light yellowish brown and pale brown loam about 16 inches thick. The subsoil is pink clay about 8 inches thick. The next layer is a strongly cemented hardpan about 14 inches thick. Siltstone is at a depth of 38 inches. Depth to the hardpan ranges from 20 to 40 inches. In some areas the surface layer is clay loam.

APPENDIX 2

TO

SOUTH SUTTER WATER DISTRICT

WATER MANAGEMENT PLAN

SSWD Rules & Regulations for

Distribution and Use of Water

&

Sample Notifications and Invoices

to SSWD Water Users

RULES AND REGULATIONS FOR THE DISTRIBUTION AND USE OF WATER

AS REVISED AND ADOPTED

AUGUST 31, 1993

SOUTH SUTTER WATER DISTRICT
2464 PACIFIC AVENUE
TROWBRIDGE, CALIFORNIA

1. OPERATION AND CONTROL OF DISTRICT WORKS

All District works, including diversion works, canals, ditches, pipelines, pump diversions, farm turnouts and other structures belonging to the District will be operated and maintained by the District, and the operation and control of such facilities will be under the exclusive control of the District. All pumps owned by water users will be maintained by the owner, but the times and amounts of flow of such pumps will be under the control of the District. The location and number of turnouts from District canals or diversion pumps from natural water courses diverting District water and the time and manner of making deliveries therefrom shall be determined by the District so as to secure safe and efficient operation of such canals or water-courses, the proper measurement of water therefrom, and to provide a uniform flow to all users.

2. USE OF AND TAMPERING AND DAMAGING DISTRICT FACILITIES

Adjustment of flow of District water or manipulation of weirs, headgates, outlets, pumps, meters, or other structures is forbidden, unless permission is given by the watertender or other authorized employee of the District.

The District will not be responsible for any loss or damage resulting from open ditch or drainage cuts, or improperly closed ditch or drainage cuts made by the landowner or tenant.

Use of District rights-of-way for vehicle or equipment moving or any use otherwise shall in all instances be considered permissive and revocable by the District at any time. Any damage to District facilities occasioned by any such use shall be the responsibility of the user and the person on whose behalf the use is made.

In instances of farm tenancies, both the owner and the tenant shall be jointly and severally liable. Where unauthorized interference with the District's system occurs, the cost of restoring the system to its normal operating condition whether by repair, replacement, readjustment or otherwise shall be payable on demand to the District and in no event shall the amount so payable be less than Fifty Dollars ($50.00) in respect to any one violation.

3. DAMS AND DIVERSIONS IN CHANNELS OR DRAINS

All dams constructed within the boundaries of the District for the purpose of diverting water from stream channels for irrigation by gravity or pump diversion must be built in accordance with the specifications of the District Engineer at the sole expense of the landowner. The District shall have the right to remove or modify any dam or diversion structure which interferes with the steady and regular flow or diversion of District water in natural channels or drains and the owner of the installation agrees to such removal if interference occurs.

Diversion of District water from these sources by adjacent landowners will be permitted only as provided in these Rules and Regulations.

All landowner turbines pumping into canals or streams for credit or transporting by the District shall have automatic restarts in the event of a power failure.

4. FARM TURNOUT DIVERSION

Diversion of District water from the facilities of District canals, Bear River Drive Pipeline and lift pumps shall be made through metered turnouts. Such facilities to serve the adjacent lands will be controlled and operated by the District. Facilities, in addition to those initially installed, shall be added or change made in their location or service only with the approval of the District and at the sole expense of the landowner, including any checkdrop structure or other facilities required for such service.

Applications for water service requiring new installations must be submitted to the District prior to November 1st in order to enable water delivery to be made during the ensuing season.

All landowners with lowlift turbines or booster pumps shall have Pacific Gas & Electric contracts that shall run on a twenty four (24) hour basis until irrigation is complete.

5. PUMP LIFT DIVERSION

Pump lift diversions shall in all respects be subject to all District regulations governing the use of water.

Any lift pump installed for the purpose of diverting District water must have the approval of the District as to location for access, ability to meter, and must have a device installed to throttle or bypass enough water to allow the pump to run on a 24 hour basis, and enable the flow to be cut during periods of rationing on the particular facility.

The District will establish a reduced water charge to the water user utilizing low lift pumps to help offset the cost of pump ownership and/or electrical energy charges. The amount of such reduced charge will be set annually by the District in order to attempt to provide a greater equality between the cost of water to the user receiving a gravity supply and the user required to utilize a low lift pump.

6. LIABILITY FOR DAMAGE

The District will not be liable for any damage caused by the negligence or carelessness of any consumer in the use of water or failure on his part to maintain any ditch for which he is wholly or in part responsible.

Any claim for compensation resulting from District operations must be prepared and filed within the time and manner prescribed by Section 710ff of the California Government Code.

The District reserves the right to stop the flow in any stream, channel or ditch at any time that the District may determine it to be necessary.

7. OBSTRUCTIONS OF CANALS OR RIGHT-OF-WAY

No fences shall be built or trees planted or other obstructions or structures placed on any right-of-way or other property of the District.

Any person entering upon the property of the District does so at his own risk.

The District will not be responsible for any damage to machinery, equipment or motor vehicles which are either operated or stored on canal banks or rights-of-way.

8. ENCROACHMENT

An Encroachment Permit shall be required before any drains, crossings, fences and other encroachments from private sources will be permitted to be used or installed connecting with or traversing a District right-of-way.

All encroachments must first be approved by the District and works shall be constructed to District specifications at the sole expense of the applicant and maintained under the supervision and to the satisfaction of the District.

If a permit is granted, the applicant shall be solely responsible for and shall indemnify and save the District harmless from any and all liability for injuries to persons or damage to property caused or resulting in any manner from the applicant's exercise of the rights and privileges given in the granting of the Encroachment Permit.

An Encroachment Permit shall in no instance be construed as the grant of a permanent right, and if the District determines at a future date that the encroachment in fact interferes with its operations, the encroachment shall be removed and the District's facility restored to its original state at the sole expense of the permittee.

9. APPLICATION FOR SERVICE

All water users shall make applications for service and all applications received prior to February 15th shall be deemed timely. Applications filed subsequent to February 15th shall be approved by the Board of Directors after determination of the available water supply. All applications shall be made to the District office on forms provided by the District.

All applications shall be signed by both the landowner and the tenant and shall show the crops and true acreage of each crop that is intended to be irrigated under the application. In addition, each application shall include a description of the tract to be irrigated, the name and address of the party to be billed for irrigation service, and such other information as the District may require from time to time.

No application will be accepted and service will be refused unless all prior charges,upon all lands owned by the landowner applicant, including, but not limited to, water bills, standby charges and District assessments, including any penalties and interest thereon for all prior years have been paid.

Applications for service must be on a full seasonal basis by regular application. Payment for all water used shall be at regular District rates. Use of water shall be subject to the District Rules and Regulations, regardless of any claim of existing water right which the user may assert to any portion of such flow. The District will not accept any application for service designed to fill out private claims of right for a portion of the irrigation season.

Service of water will not be made to any lands not covered by an application filed within the time and in the manner specified in these rules.

10. PAYMENTS

Bills for irrigation water, under application, shall be payable at the office of the District in advance in two (2) installments, in amounts to be set annually by the Board, the first installment due April 1, must be paid five (5) days prior to delivery of water, second installment due July 1, delinquent August 1. A ten (10) percent penalty will be added on delinquency. If additional payment is due after the irrigation season, it will become payable November 1, delinquent January 15, of the following year. A ten (10) percent penalty will be added on delinquency and one (1) percent per month interest charged until paid.

In no event will delivery of water be made to any land until the initial installment payment required by the application for water service covering such land is received by the District.

A penalty of ten (10) percent and interest of one (1) percent per month will be added to each delinquent charge from date of delinquency until paid or until the delinquency plus the accrued penalty is added to the Assessment Roll. Each delinquent charge plus the accrued penalty shall be added to the annual assessment and shall constitute a lien as a part of the assessment levied on the property upon which the water was used.

Normally, no service charge will be made by the District to offset the costs of providing and maintaining the facilities and turnouts necessary to the beneficial application of District water to land within the District. However, the District reserves the right to establish such service charge or remove the facilities in instances where protracted non-use becomes financially detrimental to the District.

If the water user should fail to pay the water bill prior to delinquency, the responsibility will be borne by the landowner.

11. DELIVERY AND MEASUREMENT

The time of initial and final deliveries of water each season shall be determined and fixed by the District. No water except District water shall be transported in or diverted from District canals or works without the written consent of the District. If such permit is given, facilities determined by the District to be necessary to insure the proper and safe diversion, transportation and measurement of non-District water shall be provided at the sole expense of the landowner.

Water delivery and measurement to the individual user will be on a 24 hour day use basis, and will be under the supervision and control of a watertender, who will be assigned to a specific area and be the authorized agent of the District.

In order to prevent commingling of water claimed by the landowner with that served by the District, the District will not deliver any water to any lands onto which the landowner also diverts and uses water under a claim of right unless all water use on said lands, whether lifted from channels or released from District canals, is purchased by the water-user for the entire season of irrigation.

12. REQUESTS FOR DELIVERY

Requests for water service changes affecting any outlet or diversion will be placed in effect only during the watertender's normal working hours, and then only if the request for the change of service shall have been received and approved by the effected watertenders between the hours of 8:00 a.m. and 5:00 p.m. of the preceding day.

At 5:00 p.m. watertenders will compute their next days needs and transmit them to the damtender. All water distribution personnel will then be made aware of the next days change in relation to their areas. Changes of delivery requested by water users after this time will not be considered for next day delivery.

Water delivery will be made on a seven (7) day per week basis throughout the irrigation season April 1 to October 1.

At the beginning of each season several days notice may be necessary to enable the District's work force to fill and raise the effected canal to the necessary elevations for diversion.

Changes of delivery to water users will be made strictly on a time of water travel and when available basis to provide a steady flow to other users. If and when the amount of water available, through operating errors or other causes, is not sufficient to increase flows as requested by users, the first ordered, first served rule will apply.

13. TIME OF RESERVOIR DIVERSION

Diversions from the reservoir, including diversions for Camp Far West Irrigation District, will be made once daily at approximately 5:00 a.m. so that the changes of flow will insure a steady flow and canal safety overnight. This will further enable water distribution personnel to be aware of overages and shortages of water in sufficient time to include corrections in their requirements for the next day.

14. ALLOCATIONS OF WATER

Determination of the amount of water available for distribution during the irrigation season will be made at the Board meeting preceding March 1st of each year, and will be a conservative estimate of the maximum project yield based upon run-off forecasts and past records. If applications for the season exceed the amount of such estimate, allocation of water shall be made in a manner authorized by the California Water Code and as determined by the District.

If it is determined that sufficient water supply exists to serve late applications after supplying all timely applications in full, late applications will be filled in order of their receipt until the estimated amounts of use of such applications equal the amount of water available, as set by the Board. In no event shall the District be liable for any loss or damage arising directly or indirectly from a deficiency in water supply resulting from drought or other cases, or on account of any circumstances beyond the control of the District.

In the event the demand for water in a particular facility temporarily exceeds the capacity of the distribution facilities, water will be distributed on a first ready for delivery, first served basis with a maximum flooding head appropriate to the outlet capacity and irrigated acreage, as determined by the Watermaster. When more than one farm unit is awaiting service on a particular facility, the Watermaster's determination of priority will include first the date of order and second, the expected time of flooding, as determined by outlet capacity and irrigated acreage.

15. CANAL CAPACITIES

Water in canals will not be maintained above design, or safe, capacities or elevations as established by the Watermaster.

16. TWO OR MORE SERVICES AND FREQUENT CHANGES OF A SINGLE SERVICE

In the event a water user has two or more outlets in his farming operation on the Bear River Drive Pipeline, changes of service will be made from one to the other, if prior to 3:00 p.m., but the flow must continue on a 24 hour basis until the irrigation is completed, exactly as if the users operation was serviced by a single outlet.

When a service is discontinued to a users outlet or outlets on any distribution facility, service may not be resumed to that user within a period of 24 hours.

17. TURNOFFS AT OTHER THAN NORMAL TIME

If a turnoff is necessary at other than normal water travel time or other than normal work hours (8:00 a.m. to 5:00 p.m.) the amount of water that would have been used between turnoff and normal water travel time will be computed on the water record card and charged accordingly.

This charge will not apply if the facility is short of water and the water from turnoff is needed within the system, and:

1. Sufficient notice was given of the intended turnoff; and

   (a) The turnoff is made during normal work hours.

18. SPRINKLER SYSTEMS

Water-users employing sprinkler systems on the Bear River Drive Pipeline will utilize some method of changing their lines that will minimize the amount of water retained in the District's pipeline to avoid damages caused by changes of flow to other users.

19. WASTE OF WATER

Any water-user, who willfully, carelessly or otherwise wastes water on roads, vacant land or land previously irrigated, or who floods certain portions of the land to an unreasonable depth, or who uses an unreasonable amount of water in order to irrigate properly other portions, or who irrigates land which has been improperly checked for the economical use of water, or who allows an unnecessary amount of water to escape from any tailgate, will be refused the use of water until such conditions are remedied or will have his use curtailed by the amount of water wasted, as the District may determine. This rule is for the sole purpose of preventing waste of irrigation water made available by District and is not for the purpose of controlling the time or the amount of drainage water resulting from such irrigation.

The District reserves the right to refuse delivery of water to any lands when it appears to the satisfaction of the District that its proposed use or method of use would require such excessive quantities of water as would constitute waste.

20. DRAINAGE OF IRRIGATION WATER

District assumes no responsibility for the disposition of drainage water within the District whether resulting from use of the District water supply or otherwise and District will not supervise or attempt to control the disposition or release of such drainage water. It shall be the responsibility of each landowner or irrigator to supervise or control the drainage water resulting from his irrigation practices to assure that releases are not made at such time or in such manner as to exceed the capacity of the drainage ditch, slough or creek into which such drainage water is released or discharged to the detriment of any downstream landowner adjoining such ditch, slough or creek.

21. ACCESS TO LANDS

The agents and employees of the District shall have free access at all times to all lands for the purpose of examining the ditches and the flow of water therein and for the purpose of verifying the acreage of crops on lands irrigated.

22. OWNERSHIP OF RETURN FLOWS

All deliveries of water by the District are made upon the condition that all return flows and drainage water resulting therefrom become the property of the District, for the purpose of resale, when the return flows and drainage waters flow off the parcel of land for which application has been made to the District for water service.

23. SUBDIVISION OF LANDS

Where a division of property is made creating smaller parcels requiring separate service by the District, the landowner is responsible for providing access to such smaller parcels as required for service by the District, and the cost of any additional facilities required to provide such service shall be borne by the landowner.

24. IDLE OR IMPROPERLY MAINTAINED PROPERTY

If a landowners property, due to but not limited to, government programs or rotation of planting is left idle and the property becomes a nuisance to the operation of the District facilities because of weed growth, i.e. witchgrass (common name tickle grass) it will be the responsibility of the landowner to work the acreage sufficiently to relieve the hazard or burn the acreage. Failure to remedy the hazard in a timely manner after notification by the

District will result in the District burning or working the acreage and charging the landowner for costs incurred.

Adopted: August 31, 1993

March 5, 1999

**TO: LANDOWNERS WITHIN THE AVAILABILITY AREA
OF SOUTH SUTTER WATER DISTRICT**

Based upon current water applications on hand and the amount of water estimated to be available from Camp Far West Reservoir, applications are in excess of the anticipated supply. (Expected reservoir yield 88,000 acre feet.)

Therefore, based upon the anticipated reservoir yield, the total acres in the Availability Area and the total of all applications on file, your allocation of District water will be as follows: **AS OF MARCH 1, 1999 APPROXIMATELY 2.0 ACRE FEET** per acre for the 1999 season. At the present time the District is not certain how much, if any, surplus water can be supplied from Nevada Irrigation District. If additional water becomes available it will be distributed on a pro-rata acreage basis to all crop users.

HOWEVER, AS THE APPLICANT, IF YOU PLANT THE NUMBER OF ACRES UNDER APPLICATION, THE DEVELOPMENT OF ANY WATER OVER AND ABOVE THE APPROXIMATE ACRE FEET SUPPLIED BY THE DISTRICT WILL REMAIN YOUR RESPONSIBILITY.

On January 26, 1999 the Board of Directors established the following water rates and standby charge for the 1999 irrigation season:

Gravity water ------------------------------- $5.00 per acre foot

Water diverted from drains,
sloughs or canals through
landowners own pumps ----------------------- $4.00 per acre foot

Water diverted through Bear
River Drive pipeline ------------------------- $9.00 per acre foot

Payment of Water Tolls:

½ on April 1, 1999 --------------***Must be paid at least 5 days prior to delivery of water***

½ on July 1, 1999 --------------Delinquent August 1, 1999, 10% penalty on delinquency

Balance due November 1, 1999 -------- ***Delinquent February 1, 2000, 10% penalty on delinquency***

A Standby Charge of $1.20 per acre has been established, to be collected from each acre within the water availability area. The charge is payable July 1, 1999 and ***delinquent February 1, 2000***.

The Board will impose a surcharge to help defray the cost of supplemental water should it be available to the District from Nevada Irrigation District. The total surcharge shall not exceed $2.00 per acre foot.

Water delivery will be made on a seven (7) day per week basis throughout the irrigation season, April 15, to October 1. Charging the canal system may take as much as two to three days before deliveries can be started.

All weekend and holiday water orders will be taken at the District office by recorder. All water orders, including weekend and holidays, must be received before 5:00 p.m. to be accepted for next day delivery. In the event of an emergency (not water orders) call (530) 633-4400 or (916) 645-1877.

BOARD OF DIRECTORS
SOUTH SUTTER WATER DISTRICT

SOUTH SUTTER WATER DISTRICT
Bradley J Arnold, General Manager / Secretary
2464 PACIFIC AVENUE TROWBRIDGE, CA 95659
(530) 656-2242

03/01/1999

TO:

For water supplied by South Sutter Water District for 1999 season:

WATER ALLOCATION 2.00 A.F. PER ACRE

Total Water Allocation:	60.0	A.F.
Charge per Acre Foot:	9.00	
Total Allocation Charge:	540.00	
FIRST INSTALLMENT AMOUNT: (1/2 OF TOTAL ALLOCATION)	[redacted]	

Must be paid at least 5 days prior to delivery of water.

SOUTH SUTTER WATER DISTRICT
Bradley J Arnold, General Manager / Secretary
2464 PACIFIC AVENUE TROWBRIDGE, CA 95659
(530) 656-2242

07/01/1999

TO:

SECOND INSTALLMENT DUE JULY 1, 1999

Total Water Allocation:	60.0	A.F.
Charge per Acre Foot:	9.00	
Total Allocation Charge:	540.00	

SECOND INSTALLMENT AMOUNT: [redacted]
(1/2 OF TOTAL ALLOCATION)

THIS CHARGE BECOMES DELINQUENT AUGUST 1, 1999 AND SUBJECT TO A PENALTY OF 10% AND ADDITION OF 1% PER MONTH INTEREST THEREAFTER UNTIL PAID.

SOUTH SUTTER WATER DISTRICT
Bradley J Arnold, General Manager / Secretary
2464 PACIFIC AVENUE TROWBRIDGE, CA 95659
(530) 656-2242

11/01/1999

TO:

For water supplied by South Sutter Water District for 1998 season:

FINAL INVOICE

DATE	ITEM	CHARGES	CREDITS	BALANCE
04/21/1999	1st Installment		-302.40	-302.40
05/31/1999	16.4 a f @ $9.00	147.60		-154.80
07/01/1999	Standby Charge	366.00		211.20

BALANCE DUE	211.20

NOTE: BALANCE DUE includes "Standby Charge"!!

Will become delinquent if not paid before February 1, 1999. A 10% penalty will be assessed and 1% interest per month until paid.

APPENDIX 3

TO

SOUTH SUTTER WATER DISTRICT

WATER MANAGEMENT PLAN

SSWD Groundwater Management Plan - 1995

SOUTH SUTTER WATER DISTRICT

GROUNDWATER MANAGEMENT PLAN

Introduction

On February 23, 1993, South Sutter Water District (District) adopted a resolution of intention to draft a Groundwater Management Plan (Plan) pursuant to Water Code Section 10753. Subsequent to adopting this resolution, the District has directed the preparation of a report on groundwater conditions within the District. This report covers the period 1970 through 1993 and updated a prior report for the period 1963 to 1968.

The District is now in a position to consider all of the components set forth in Water Code Section 10753.7 and select those components which are appropriate for inclusion in the District's Plan. The primary goal in developing this Plan is to work cooperatively with landowners within the District to most efficiently manage the groundwater resources and to continue with an efficient and effective conjunctive use program.

Plan Area

The Plan area includes all District lands located within Sutter and Placer Counties. As the District proceeds with perfecting this Plan, it intends to determine if adjacent areas located within Reclamation District 1001 and Pleasant Grove-Verona Mutual Water Company may wish to join with the District in implementing a coordinated groundwater management plan for an enlarged area.

Plan Components

The following are components identified in Water Code Section 10753.7 which are included in the District's Plan.

A. Monitoring

1. Water Levels

The District currently monitors 25 wells within the District boundaries. Other monitor wells located in the area are monitored by the State Department of Water Resources (DWR) and the Sutter County Agricultural Commissioner (SCAC). The groundwater level will continue to be monitored on a semi-annual basis which includes spring and fall measurements. The groundwater level monitoring program will provide information that will allow assessment of the change in groundwater levels.

2. Quality

DWR has monitored groundwater quality in the area for many years. Although the results of this monitoring have not identified any groundwater quality problems, the District has been informed of some localized quality concerns by landowners. The District therefore, intends to work with DWR in continuing the groundwater quality monitoring program and to supplement this program to investigate the localized quality concerns.

B. **Conjunctive Use Program and Mitigation Overdraft**

The District's Camp Far West Project was developed as a conjunctive use project. Review of groundwater conditions before, during and after the droughts of 1976-77 and 1987-93 clearly show that the District's operations under the Camp Far West Project have replenished groundwater extracted by its landowners except in the southeastern portion of the District. The District will continue this conjunctive operations and continue to seek additional surface water supplies to expand its conjunctive use operations.

The elements of the District's conjunctive use program, which include required facilities, are as follows:

A source of surface water in years of high precipitation.

This element includes maximizing the use of Camp Far West Reservoir in years when the reservoir is filled. Landowners are to be encouraged to first purchase and use available surface water supplies and only use groundwater supplies when supplemental supplies are necessary.

Conveyance facilities to import.

The District has all required water delivery facilities in place to serve its customers. If it is determined that additional facilities are required to facilitate groundwater use, the District will make the necessary provisions.

Recharge facilities.

Historically, recharge to the groundwater basin has been effectively accomplished from the District's conveyance facilities and irrigation with surface water. The District will study the need for any additional facilities for recharge.

Useable storage capacity in the acquifer.

The District will take measures to protect the aquifer from overdraft, contamination and other causes which may affect the usable storage capacity of the aquifer.

Extraction facilities.

Presently, landowners maintain their private wells and pumps. The District will study the need for additional extraction facilities.

The District intends to not allow the sale of groundwater, either directly or by exchange, outside the District boundaries. Any proposal by a landowner to transport groundwater outside the District boundaries will be reviewed on a case by case basis.

C. Relations with State and Federal Regulatory Agencies

The District has a working relation with DWR in monitoring groundwater conditions in the area. The District also is involved with DWR in its study of the "Proposed Conjunctive Use Investigation American-Bear Basin". The District intends to continue to work with DWR on these programs and will work with other State and Federal regulatory agencies when appropriate to protect the groundwater basin.

D. Well Construction Policies and Administration of Well Abandonment and Destruction Program

The District has not identified any problems within the basin requiring special well construction, abandonment or destruction policies. The District, therefore, accepts the minimum standards set forth in Water Code Sections 13700 through 13806. These standards will continue to be administered by the State.

Excluded Components

Control of saline water intrusion, regulation of contaminated groundwater, land use planning to limit possible groundwater contamination and establishment of wellhead protection areas are identified as plan components in Water Code Section 10753.7 but are excluded from the Plan at this time.

These components have been excluded from the Plan because the groundwater quality monitoring program has not identified existing conditions within the basin requiring District action in these areas. If monitoring identifies any saline intrusion or contamination problems, the Plan will be modified to address the problems identified.

Plan Updating

The District intends to periodically update this Plan as data and conditions warrant. Information obtained through the groundwater monitoring program or availability of additional surface water are factors which may require modification of this Plan.

RESOLUTION NO. 95-2

WHEREAS: the South Sutter Water District on February 23, 1993 adopted Resolution 93-2 Intention of South Sutter Water District To Draft A Groundwater Management Plan and;

WHEREAS: the South Sutter Water District held hearings and received no adverse comments from landowners and;

WHEREAS: the South Sutter Water District contracted with the engineering firm of Murray, Burns & Kienlen to draft a groundwater management plan and;

WHEREAS: the South Sutter Water District called a hearing on February 21, 1995 at 2:00 p.m. at the District office to hear comments pro and con from landowners regarding the proposed groundwater management plan as proposed by the engineers, with no objections being voiced or no protests received and;

NOW THEREFORE, BE IT RESOLVED that the District Board of Directors hereby adopts the groundwater management plan submitted by Murray Burns and Kienlen.

Dated: February 28, 1995

CERTIFICATION

I, ROBERT L. MELTON, do hereby certify that I am now and at all times herein mentioned have been the duly appointed, qualified and acting Secretary of South Sutter Water District and that the foregoing is a full, true and correct copy of a resolution duly and regularly adopted at a meeting of the Board of Directors of said District held on the 28th day of February, 1995 a majority and quorum of the members of said Board being present and voting in favor of said resolution, and that said resolution has not been modified, rescinded, altered or amended and is now in full force and effect.

Dated: February 28, 1995

SOUTH SUTTER WATER DISTRICT SUTTER AND PLACER COUNTIES CALIFORNIA

Robert L. Melton, Secretary
SOUTH SUTTER WATER DISTRICT

EFFICIENT WATER MANAGEMENT PRACTICES
(EWMPs)
DETAILED ANALYSIS SPREADSHEETS

TO

SOUTH SUTTER WATER DISTRICT

WATER MANAGEMENT PLAN

South Sutter Water District

Table 1. EWMP Analysis Summary Table

	EWMP	EWMP Fully Implemented?	EWMP Demonstrably Inappropriate?	EWMP Technically Infeasible?	Environmental Effects				Third Party Allocation Effects				Indirect Economic Effects				Water Supplier B/C Ratio (25 years)	Financial Analysis (Yes/No)	EWMP Accepted? (Yes/No)
					B	N	I	IN	B	N	I	IN	B	N	I	IN			
List A. Facilitating Practices	1. Facilitate Alternate Land Use	**No**	**Yes**	**No**															**No**
	2. Facilitate Use of Available Recycled Water	**Yes**	**No**	**No**															**Yes**
	3. Facilitate Financial Assistance	**No**	**No**	**No**															**Yes**
	4. Facilitate Voluntary Water Transfers	**Yes**	**No**	**No**															**Yes**
List B	5. Line or Pipe Ditches/Canals	**Yes**	**No**	**No**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**			**Yes**
	6. Increase Water Ordering/Delivering Flexibility	**Yes**	**No**	**No**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**			**Yes**
	7. Construct/Operate Tailwater and Spill Recovery System	**Yes**	**No**	**No**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**			**Yes**
	8. Optimize Conjunctive Use	**Yes**	**No**	**No**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**			**Yes**
	9. Automate Canal Structures	**No**	**No**	**No**	**0**	**0**	**4**	**2**	**0**	**0**	**3**	**1**	**0**	**0**	**3**	**0**	**#DIV/0!**		**Yes**
List C	10. Water Measurement/Water Use Update				**0**	**0**	**6**	**1**	**0**	**0**	**3**	**1**	**0**	**0**	**3**	**0**	**#DIV/0!**		**Yes**
	11. Pricing and Incentives				**0**	**0**	**6**	**1**	**0**	**0**	**3**	**1**	**0**	**0**	**0**	**3**	**#DIV/0!**		**Yes**

Shading = "Facilitate" EWMPs that use a different analysis to determine the extent a water supplier is able to facilitate them.

B = Beneficial; I = Insignificant; N = Negative; IN = Indeterminate

Memorandum of Understanding
Regarding
Efficient Water Management Practices
by Agricultural Water Suppliers
in California

Efficient Water Management Practice (EWMP)

1. Facilitate Alternate Land Use

The Excel Version
prepared by Division of Planning and Local Assistance
Department of Water Resources
October 21, 1998

EWMP 1. Facilitate Alternate Land Use

PREVIEW / REVIEW

Part 1 Information to Determine if Detailed Analysis is Required

Question	A	*(Is EWMP satisfactorily implemented?)*	No
Question	B	*(Is EWMP demonstrably inappropriate?)*	Yes
Question	C	*(Is EWMP technically infeasible?)*	No

Part 2 Detailed Analysis for EWMPs 1, 2, 3, and 4

Question	A	*(Does EWMP impact other EWMPs?)*	
Question	B	*(Does supplier have legal authority?)*	
Question	C	*(Has supplier been approached?)*	
Question	D	*(Would supplier take active role?)*	
Question	E	*(Does supplier have funding?)*	
Question	F	*(Can supplier provide incentives?)*	
Question	G	*(Can supplier secure loans?)*	

Part 3 General Information for Detailed Analysis
(not applicable)

Part 4 Environmental, Third Party, and Indirect Economic Analysis
(not applicable)

Part 5 Economic Analysis
(not applicable)

Part 6 Financial Analysis
(not applicable)

Part 7 Summary of Analysis

Accept EWMP?	No

EWMP 1. Facilitate Alternate Land Use

Part 1. Information to Determine if Detailed Analysis Is Required

A. Is this EWMP being implemented at a satisfactory level?

○ Yes ◉ No

Please see response to B.

B. Is this EWMP demonstrably inappropriate for implementation by the water supplier?

◉ Yes ○ No

Details:

As defined in Appendix A of the MOU, the purpose of this EWMP is to assist in
the control of problem drainage. The soils within SSWD are, in general, well
drained and therefore, do not exhibit areas of inadequate drainage. In
addition, SSWD has no authority to facilitate alternative land uses and does
nothing to deter land use changes. Land use changes are determined by
individual landowners and would be served by SSWD subject to existing
rules, regulations, and boundaries. Therefore, this EWMP is demonstrably
inappropriate.

C. Is this EWMP technically infeasible given current technology or prevailing local conditions?

○ Yes ◉ No

Details:

Please see response to B.

EWMP 3. Facilitate Financial Assistance

Part 1. Information to Determine if Detailed Analysis Is Required

A. Is this EWMP being implemented at a satisfactory level?

○ Yes ◉ No

B. Is this EWMP demonstrably inappropriate for implementation by the water supplier?

○ Yes ◉ No

C. Is this EWMP technically infeasible given current technology or prevailing local conditions?

○ Yes ◉ No

EWMP 1. Facilitate Alternate Land Use

Part 7. Summary of Analysis

Initial Evaluation Table (from Part 1)

Is this EWMP ...	Yes	No
A. fully implemented?		X
B. demonstrably inappropriate?	X	
C. technically infeasible?		X

Decision about this EWMP

	Yes	No
Is this EWMP accepted?	○	◉

Discussion:

Please provide here and in the WMP a discussion of why this EWMP is accepted or rejected for implementation. Please include a discussion of estimated water savings, environmental effects, third-party effects, etc. for this EWMP.

As defined in Appendix A of the MOU, the purpose of this EWMP is to assist in
the control of problem drainage. The soils within SSWD are, in general, well
drained and therefore, do not exhibit areas of inadequate drainage. In
addition, SSWD has no authority to facilitate alternative land uses and does
nothing to deter land use changes. Land use changes are determined by
individual landowners and would be served by SSWD subject to existing
rules, regulations, and boundaries. Therefore, this EWMP is demonstrably
inappropriate.

Memorandum of Understanding
Regarding
Efficient Water Management Practices
by Agricultural Water Suppliers
in California

Efficient Water Management Practice (EWMP)

2. Facilitate Use of Available Recycled Water

The Excel Version

prepared by Division of Planning and Local Assistance

Department of Water Resources

October 21, 1998

EWMP 2. Facilitate Use of Available Recycled Water

PREVIEW / REVIEW

Part 1 Information to Determine if Detailed Analysis is Required

Question	A	*(Is EWMP satisfactorily implemented?)*	Yes
Question	B	*(Is EWMP demonstrably inappropriate?)*	No
Question	C	*(Is EWMP technically infeasible?)*	No

Part 2 Detailed Analysis for EWMPs 1, 2, 3, and 4

Question	A	*(Does EWMP impact other EWMPs?)*	
Question	B	*(Does supplier have legal authority?)*	
Question	C	*(Has supplier been approached?)*	
Question	D	*(Would supplier take active role?)*	
Question	E	*(Does supplier have funding?)*	
Question	F	*(Can supplier provide incentives?)*	
Question	G	*(Can supplier secure loans?)*	

Part 3 General Information for Detailed Analysis
(not applicable)

Part 4 Environmental, Third Party, and Indirect Economic Analysis
(not applicable)

Part 5 Economic Analysis
(not applicable)

Part 6 Financial Analysis
(not applicable)

Part 7 Summary of Analysis

Accept EWMP?	Yes

EWMP 2. Facilitate Use of Available Recycled Water

Part 1. Information to Determine if Detailed Analysis Is Required

A. Is this EWMP being implemented at a satisfactory level?

(●) Yes ( ) No

Details:

Effluent from upstream water treatment plants is discharged into streams and commingled with SSWD water supplies. Water is diverted by SSWD pursuant to its water rights, thereby utilizing all available recycled water. There is no recycled water generated within SSWD. Therefore, this EWMP is fully implemented.

B. Is this EWMP demonstrably inappropriate for implementation by the water supplier?

( ) Yes (●) No

Details:

Please see response to A.

C. Is this EWMP technically infeasible given current technology or prevailing local conditions?

( ) Yes (●) No

Details:

Please see response to A.

EWMP 2. Facilitate Use of Available Recycled Water

Part 7. *Summary of Analysis*

Initial Evaluation Table (from Part 1)

Is this EWMP …	Yes	No
A. fully implemented?	X	
B. demonstrably inappropriate?		X
C. technically infeasible?		X

Decision about this EWMP

	Yes	No
Is this EWMP accepted?	◉	○

Discussion:
Please provide here and in the WMP a discussion of why this EWMP is accepted or rejected for implementation. Please include a discussion of estimated water savings, environmental effects, third-party effects, etc. for this EWMP.

Effluent from upstream water treatment plants is discharged into streams and
commingled with SSWD water supplies. Water is diverted by SSWD pursuant
to its water rights, thereby utilizing all available recycled water. There is no
recycled water generated within SSWD. Therefore, this EWMP is fully implemented.

Memorandum of Understanding
Regarding
Efficient Water Management Practices
by Agricultural Water Suppliers
in California

Efficient Water Management Practice (EWMP)

3. Facilitate Financial Assistance

The Excel Version
prepared by Division of Planning and Local Assistance
Department of Water Resources
October 21, 1998

EWMP 3. Facilitate Financial Assistance

PREVIEW / REVIEW

Part 1 Information to Determine if Detailed Analysis is Required

Question	A	*(Is EWMP satisfactorily implemented?)*	No
Question	B	*(Is EWMP demonstrably inappropriate?)*	No
Question	C	*(Is EWMP technically infeasible?)*	No

Part 2 Detailed Analysis for EWMPs 1, 2, 3, and 4

Question	A	*(Does EWMP impact other EWMPs?)*	No
Question	B	*(Does supplier have legal authority?)*	Yes
Question	C	*(Has supplier been approached?)*	Yes
Question	D	*(Would supplier take active role?)*	Yes
Question	E	*(Does supplier have funding?)*	Yes
Question	F	*(Can supplier provide incentives?)*	No
Question	G	*(Can supplier secure loans?)*	No

Part 3 General Information for Detailed Analysis
(not applicable)

Part 4 Environmental, Third Party, and Indirect Economic Analysis
(not applicable)

Part 5 Economic Analysis
(not applicable)

Part 6 Financial Analysis
(not applicable)

Part 7 Summary of Analysis

Accept EWMP? Yes

EWMP 3. Facilitate Financial Assistance

Part 2. Detailed Analysis

A. Does this EWMP impact any of the other EWMPs on List B and/or List C?

○ Yes ◉ No

B. Does the water supplier have the legal authority to implement this EWMP?

◉ Yes ○ No

C. Has the water supplier approached or been approached by any customers or other entities concerning the potential for implementing this EWMP?

◉ Yes ○ No

Discussion:

Individual growers have inquired as to the availability of funding for particular projects and SSWD is responding by developing a list of available funding sources, such as grants and loans. The information is anticipated to be available for water users by December 2004, with the assistance of the Department of Water Resources.

D. If the water supplier were to be approached with a proposal endorsed by water users, would the water supplier be willing to take an active role in facilitating this request?

◉ Yes ○ No

Discussion:

SSWD will gather and make available information on available funding sources for customers. The information will include, but not be limited to procedures, potential future requirements, and funding source contact information. SSWD will coordinate with DWR to develop the list of available funding sources.

E. Does the water supplier have adequate funding sources, or could funds reasonably be made available to implement this EWMP?

- [x] Yes
- [ ] No

Discussion:

SSWD's Water Conservation Coordinator will gather the financial assistance information and, upon completion of the list by December 2004 in cooperation with DWR, have the list available for water users. SSWD is providing the funding to develop the list of funding opportunities.

F. Could the water supplier provide any incentives to customers for this EWMP?

- [ ] Yes
- [x] No

Discussion:

SSWD will provide the water users with a list of available funding sources, associated procedures and requirements. The water users may then determine their individual need and apply accordingly.

G. Does the water supplier have the ability to secure and/or administer low-interest loans for customers?

- [ ] Yes
- [x] No

Discussion:

SSWD is not in a position to secure or administer low-interest loans due to other funding commitments and time constraints.

EWMP 3. Facilitate Financial Assistance

Part 7. Summary of Analysis

Initial Evaluation Table (from Part 1)

Is this EWMP …	Yes	No
A. fully implemented?		X
B. demonstrably inappropriate?		X
C. technically infeasible?		X

Decision about this EWMP

	Yes	No
Is this EWMP accepted?	◉	○

Discussion:

Please provide here and in the WMP a discussion of why this EWMP is accepted or rejected for implementation. Please include a discussion of estimated water savings, environmental effects, third-party effects, etc. for this EWMP.

SSWD accepts this EWMP and is dedicated to providing the water users with
information on available funding sources. Considering that the information is not yet
available to water users, this EWMP is not fully implemented. Estimated water
savings, environmental effects, and third party effects are unknown and are
anticipated to be dependent upon the type of projects developed by individual users.

Memorandum of Understanding Regarding Efficient Water Management Practices by Agricultural Water Suppliers in California

Efficient Water Management Practice (EWMP)

4. Facilitate Voluntary Water Transfers

The Excel Version
prepared by Division of Planning and Local Assistance
Department of Water Resources
October 21, 1998

EWMP 4. Facilitate Voluntary Water Transfers

PREVIEW / REVIEW

Part 1 Information to Determine if Detailed Analysis is Required

Question	A	*(Is EWMP satisfactorily implemented?)*	Yes
Question	B	*(Is EWMP demonstrably inappropriate?)*	No
Question	C	*(Is EWMP technically infeasible?)*	No

Part 2 Detailed Analysis for EWMPs 1, 2, 3, and 4

Question	A	*(Does EWMP impact other EWMPs?)*	
Question	B	*(Does supplier have legal authority?)*	
Question	C	*(Has supplier been approached?)*	
Question	D	*(Would supplier take active role?)*	
Question	E	*(Does supplier have funding?)*	
Question	F	*(Can supplier provide incentives?)*	
Question	G	*(Can supplier secure loans?)*	

Part 3 General Information for Detailed Analysis
(not applicable)

Part 4 Environmental, Third Party, and Indirect Economic Analysis
(not applicable)

Part 5 Economic Analysis
(not applicable)

Part 6 Financial Analysis
(not applicable)

Part 7 Summary of Analysis

Accept EWMP?	Yes

EWMP 4. Facilitate Voluntary Water Transfers

Part 1. Information to Determine if Detailed Analysis Is Required

A. Is this EWMP being implemented at a satisfactory level?

◉ Yes ○ No

Details:

SSWD currently facilitates and promotes voluntary water transfers amoungst single farm units based on ownership within the SSWD service area. This means that, for example, a farming corporation may fully irrigate a crop with surface water on a particular field using the combined allocations from other fields owned by the corporation. The other fields are followed or irrigated with groundwater. Records of past voluntary surface water transfers are not maintained by SSWD. Voluntary surface water transfers between different landowners are not permitted. During drought periods, SSWD permits the flexibility to convey groundwater through SSWD facilities, if capacity is available, for use amoungst single farm units based on ownership. Therefore, this EWMP is fully implemented.

B. Is this EWMP demonstrably inappropriate for implementation by the water supplier?

○ Yes ◉ No

Details:

Please see response to A.

C. Is this EWMP technically infeasible given current technology or prevailing local conditions?

○ Yes ◉ No

Details:

Please see response to A.

EWMP 4. Facilitate Voluntary Water Transfers

Part 7. Summary of Analysis

Initial Evaluation Table (from Part 1)

Is this EWMP ...	Yes	No
A. fully implemented?	X	
B. demonstrably inappropriate?		X
C. technically infeasible?		X

Decision about this EWMP

	Yes	No
Is this EWMP accepted?	◉	○

Discussion:

Please provide here and in the WMP a discussion of why this EWMP is accepted or rejected for implementation. Please include a discussion of estimated water savings, environmental effects, third-party effects, etc. for this EWMP.

SSWD currently facilitates and promotes voluntary water transfers amoungst single farm units based on ownership within the SSWD service area. This means that, for example, a farming corporation may fully irrigate a crop with surface water on a particular field using the combined allocations from other fields owned by the corporation. The other fields are followed or irrigated with groundwater. Records of past voluntary surface water transfers are not maintained by SSWD. Voluntary surface water transfers between different landowners are not permitted. During drought periods, SSWD permits the flexibility to convey groundwater through SSWD facilities, if capacity is available, for use amoungst single farm units based on ownership. Therefore, this EWMP is fully implemented.

Memorandum of Understanding
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Efficient Water Management Practice (EWMP)

5. Line or Pipe Ditches/Canals

The Excel Version
prepared by Division of Planning and Local Assistance
Department of Water Resources
October 21, 1998

EWMP 5. Line or Pipe Ditches/Canals

PREVIEW - REVIEW

Part 1 Information to Determine if Detailed Analysis is Required

Question A	*(Is EWMP satisfactorily implemented?)*	Yes
Question B	*(Is EWMP demonstrably inappropriate?)*	No
Question C	*(Is EWMP technically infeasible?)*	No

Part 2 Detailed Analysis for EWMPs 1, 2, 3, and 4 (not applicable)

Part 3 General Information for Detailed Analysis

Question A	*(Does EWMP impact other EWMPs?)*	
Question B	*(Matrix information about seepage flows)*	n/a
Question C	*(Was EWMP considered along with others?)*	

Part 4 Environmental, Third Party, and Indirect Economic Analysis

Environmental Effects

Question A	*(On source of supply)*	
Question B	*(On groundwater levels)*	
Question C	*(On shallow groundwater)*	
Question D	*(On instream flows)*	
Question E	*(On drain flows)*	
Question F	*(On herbicide/pesticide use)*	
Question G	*(On soil erosion)*	
Question H	*(On field burning/fugitive dust)*	
Question I	*(On energy use)*	
Question J1	*(On vernal pools and swales)*	
Question J2	*(On riparian habitats)*	
Question J3	*(On open water bodies)*	
Question J4	*(On marshes)*	

EWMP 5. Line or Pipe Ditches/Canals

Third-Party Effects

Question A	(On groundwater levels)	
Question B	(On instream flows)	
Question C	(On drain flows)	
Question D	(On herbicide/pesticide use)	
Question E	(On wind/water soil erosion)	

Indirect Economic Effects

Question A	(On local economies via farm operations)	
Question B	(On farmers' purchases of crop inputs)	
Question C	(On hiring of local farm workers)	
Question D	(On local processing of farm produce)	

Part 5 Economic Analysis

Question A	(Estimated annual conserved water)		af
Question B	(Would EWMP result in capital costs?)		
Question C	(Would EWMP reduce water purchases?)		
Question D	(Would EWMP delay future projects?)		
Question E	(Would EWMP increase water sales?)		

Part 6 Financial Analysis

Adequate funding available?	

Part 7 Summary of Analysis

Benefit-Cost Ratio	
Accept EWMP?	Yes

EWMP 5. Line or Pipe Ditches/Canals

Part 1. Information to Determine if Detailed Analysis Is Required

A. Is this EWMP being implemented at a satisfactory level?

(•) Yes ( ) No

Details:

SSWD lines and pipes ditches and canals as required to meet operational needs. The unlined portion of the SSWD system provides valuable recharge to the groundwater basin, which is relied upon by users in all years and most significantly, in drier years. The conveyance losses account for approximately 6,000 AF per year of groundwater recharge. Lining or piping additional parts of the system may have negative environmental effects. Therefore, this EWMP is fully implemented.

B. Is this EWMP demonstrably inappropriate for implementation by the water supplier?

( ) Yes (•) No

Details:

Please see response to A.

C. Is this EWMP technically infeasible given current technology or prevailing local conditions?

( ) Yes (•) No

Details:

Please see response to A.

EWMP 5. Line or Pipe Ditches/Canals

Part 7. Summary of Analysis

Initial Evaluation Table (from Part 1)

EWMP	Yes	No
Fully implemented?	**X**	
Demonstrably Inappropriate?		**X**
Technically Infeasible?		**X**

EWMP 5. Line or Pipe Ditches/Canals

Part 7. Summary of Analysis

Potential Environmental Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Source of supply				
B	Confined/Unconfined Groundwater Levels				
C	Shallow Groundwater Elevations				
D	Instream Flows				
E	Drain Flows				
F	Fertilizer / Herbicide / Pesticide Use				
G	Soil Erosion				
H	Field Burning and Fugitive Dust				
I	Energy Use				
J1	Vernal Pools and Swales				
J2	Riparian Habitat				
J3	Open Water Bodies				
J4	Marshes (permanent or seasonal)				

EWMP 5. Line or Pipe Ditches/Canals

Part 7. Summary of Analysis

Potential Third-Party Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Confined/Unconfined Groundwater Levels				
B	Instream Flows				
C	Drain Flows				
D	Fertilizer / Herbicide / Pesticide Use				
E	Wind/Water Soil Erosion				

Indirect Economic Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
B	Farm Inputs				
C	Local farm Labor				
D	Processing of Farm Products				

EWMP 5. Line or Pipe Ditches/Canals

Part 7. Summary of Analysis

EWMP Economic Analysis (from Part 5)

Water Supplier B/C Ratio	

EWMP Financial Analysis (from Part 6)

	Yes	No
Can adequate funding be expected to be made available?	○	○

EWMP 5. Line or Pipe Ditches/Canals

Part 7. Summary of Analysis

Decision about EWMP

	Yes	No
Is this EWMP accepted?	◉	○

Discussion:

Please provide here and in the WMP a discussion of why the EWMP is accepted or rejected for implementation. Please include a discussion of estimated water savings, environmental effects, third-party effects, etc. for this EWMP.

SSWD lines and pipes ditches and canals as required to meet operational needs.
The unlined portion of the SSWD system provides valuable recharge to the
groundwater basin, which is relied upon by users in all years and most
significantly, in drier years. The conveyance losses account for approximately
6,000 AF per year of groundwater recharge. Lining or piping additional parts
of the system may have negative environmental effects. Therefore, this EWMP is
fully implemented.

Memorandum of Understanding
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in California

Efficient Water Management Practice (EWMP)

6. Increase Water Ordering/Delivering Flexibility

The Excel Version
prepared by Division of Planning and Local Assistance
Department of Water Resources
October 21, 1998

EWMP 6. Increase Water Ordering/Delivering Flexibility

PREVIEW - REVIEW

Part 1 Information to Determine if Detailed Analysis is Required

Question	A	*(Is EWMP satisfactorily implemented?)*	Yes
Question	B	*(Is EWMP demonstrably inappropriate?)*	No
Question	C	*(Is EWMP technically infeasible?)*	No

Part 2 Detailed Analysis for EWMPs 1, 2, 3, and 4 (not applicable)

Part 3 General Information for Detailed Analysis

Question	A	*(Does EWMP impact other EWMPs?)*	
Question	B	*(Description of facilities and components)*	n/a
Question	C	*(Was EWMP considered along with others?)*	

Part 4 Environmental, Third Party, and Indirect Economic Analysis

Environmental Effects

Question	A	*(On source of supply)*	
Question	B	*(On groundwater levels)*	
Question	C	*(On shallow groundwater)*	
Question	D	*(On instream flows)*	
Question	E	*(On drain flows)*	
Question	F	*(On herbicide/pesticide use)*	n/a
Question	G	*(On soil erosion)*	
Question	H	*(On field burning/fugitive dust)*	n/a
Question	I	*(On energy use)*	
Question	J	*(On habitats)*	n/a

EWMP 6. Increase Water Ordering/Delivering Flexibility

Third-Party Effects

Question A	*(On groundwater levels)*	
Question B	*(On instream flows)*	
Question C	*(On drain flows)*	
Question D	*(On herbicide/pesticide use)*	**n/a**
Question E	*(On wind/water soil erosion)*	

Indirect Economic Effects

Question A	*(On local economies via farm operations)*	
Question B	*(On farmers' purchases of crop inputs)*	
Question C	*(On hiring of local farm workers)*	
Question D	*(On local processing of farm produce)*	

Part 5 Economic Analysis

Question A	*(Estimated annual conserved water)*	**af**
Question B	*(Would EWMP result in capital costs?)*	
Question C	*(Would EWMP reduce water purchases?)*	
Question D	*(Would EWMP delay future projects?)*	
Question E	*(Would EWMP increase water sales?)*	

Part 6 Financial Analysis

Adequate funding available?

Part 7 Summary of Analysis

Benefit-Cost Ratio

Accept EWMP? **Yes**

EWMP 6. Increase Water Ordering/Delivering Flexibility

Part 1. Information to Determine if Detailed Analysis Is Required

A. Is this EWMP being implemented at a satisfactory level?

◉ Yes ○ No

Details:

SSWD believes that this EWMP is fully implemented in terms of flexibility in frequency, rate, and duration of water availability because of delivery system characteristics. SSWD requires prior notice by the water user to obtain water which allows the District to make the necessary adjustments to the system control structures. There have been no complaints to the District regarding delivery flexibility.

B. Is this EWMP demonstrably inappropriate for implementation by the water supplier?

○ Yes ◉ No

Details:

Please see response to A.

C. Is this EWMP technically infeasible given current technology or prevailing local conditions?

○ Yes ◉ No

Details:

Please see response to A.

EWMP 6. Increase Water Ordering/Delivering Flexibility

Part 7. Summary of Analysis

Initial Evaluation Table (from Part 1)

EWMP	Yes	No
Fully implemented?	**X**	
Demonstrably Inappropriate?		**X**
Technically Infeasible?		**X**

EWMP 6. Increase Water Ordering/Delivering Flexibility

Part 7. Summary of Analysis

Potential Environmental Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Source of supply				
B	Confined/Unconfined Groundwater Levels				
C	Shallow Groundwater Elevations				
D	Instream Flows				
E	Drain Flows				
F	Fertilizer / Herbicide / Pesticide Use				
G	Soil Erosion				
H	Field Burning and Fugitive Dust				
I	Energy Use				
J1	Vernal Pools and Swales				
J2	Riparian Habitat				
J3	Open Water Bodies				
J4	Marshes (permanent or seasonal)				

EWMP 6. Increase Water Ordering/Delivering Flexibility

Part 7. Summary of Analysis

Potential Third-Party Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Confined/Unconfined Groundwater Levels				
B	Instream Flows				
C	Drain Flows				
D	Fertilizer / Herbicide / Pesticide Use				
E	Wind/Water Soil Erosion				

Indirect Economic Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
B	Farm Inputs				
C	Local farm Labor				
D	Processing of Farm Products				

EWMP 6. Increase Water Ordering/Delivering Flexibility

Part 7. Summary of Analysis

EWMP Economic Analysis (from Part 5)

Water Supplier B/C Ratio	

EWMP Financial Analysis (from Part 6)

	Yes	No
Can adequate funding be expected to be made available?	○	○

EWMP 6. Increase Water Ordering/Delivering Flexibility

Part 7. Summary of Analysis

Decision about EWMP

	Yes	No
Is this EWMP accepted?	◉	○

Discussion:

Please provide here and in the WMP a discussion of why the EWMP is accepted or rejected for implementation. Please include a discussion of estimated water savings, environmental effects, third-party effects, etc. for this EWMP.

SSWD believes that this EWMP is fully implemented in terms of flexibility in frequency, rate, and duration of water availability because of delivery system characteristics. SSWD requires prior notice by the water user to obtain water which allows the District to make the necessary adjustments to the system control structures. There have been no complaints to the District regarding delivery flexibility.

Memorandum of Understanding
Regarding
Efficient Water Management Practices
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Efficient Water Management Practice (EWMP)

7. Construct/Operate Tailwater and Spill Recovery System

The Excel Version
prepared by Division of Planning and Local Assistance
Department of Water Resources
October 21, 1998

EWMP 7. Construct/Operate Tailwater and Spill Recovery System

PREVIEW - REVIEW

Part 1 Information to Determine if Detailed Analysis is Required

Question A	*(Is EWMP satisfactorily implemented?)*	Yes
Question B	*(Is EWMP demonstrably inappropriate?)*	No
Question C	*(Is EWMP technically infeasible?)*	No

Part 2 Detailed Analysis for EWMPs 1, 2, 3, and 4 (not applicable)

Part 3 General Information for Detailed Analysis

Question A	*(Does EWMP impact other EWMPs?)*	
Question B	*(Matrix information about seepage losses)*	n/a
Question C	*(Matrix information about spill water quality)*	n/a
Question D	*(Description of potential water reuse system)*	n/a
Question E	*(Was EWMP considered along with others?)*	

Part 4 Environmental, Third Party, and Indirect Economic Analysis

Environmental Effects

Question A	*(On source of supply)*	
Question B	*(On groundwater levels)*	
Question C	*(On shallow groundwater)*	
Question D	*(On instream flows)*	
Question E	*(On drain flows)*	
Question F	*(On herbicide/pesticide use)*	n/a
Question G	*(On soil erosion)*	
Question H	*(On field burning/fugitive dust)*	n/a
Question I	*(On energy use)*	
Question J	*(On habitats)*	n/a

EWMP 7. Construct/Operate Tailwater and Spill Recovery System

Third-Party Effects

Question A	*(On groundwater levels)*	
Question B	*(On instream flows)*	
Question C	*(On drain flows)*	
Question D	*(On herbicide/pesticide use)*	n/a
Question E	*(On wind/water soil erosion)*	

Indirect Economic Effects

Question A	*(On local economies via farm operations)*	
Question B	*(On farmers' purchases of crop inputs)*	
Question C	*(On hiring of local farm workers)*	
Question D	*(On local processing of farm produce)*	

Part 5 Economic Analysis

Question A	*(Estimated annual conserved water)*		af
Question B	*(Would EWMP result in capital costs?)*		
Question C	*(Would EWMP reduce water purchases?)*		
Question D	*(Would EWMP delay future projects?)*		
Question E	*(Would EWMP increase water sales?)*		

Part 6 Financial Analysis

Adequate funding available?

Part 7 Summary of Analysis

Benefit-Cost Ratio

Accept EWMP? **Yes**

EWMP 7. Construct/Operate Tailwater and Spill Recovery System

Part 1. Information to Determine if Detailed Analysis Is Required

A. Is this EWMP being implemented at a satisfactory level?

(●) Yes ( ) No

Details:

SSWD believes it has implemented this EWMP to a satisfactory level as individual water users capture tailwater internally to the District, which results in insignificant quantities of water that spill at the end of its system. Therefore, SSWD believes that there is no further opportunity to capture tailwater. However, to support the belief, EWMP #10 would aid to understand the quantity of tailwater discharging from the system. The estimated timeline and budget to complete an investigation and summary package for these EWMPs are detailed in the WMP. Further detail is described under EWMP #10.

B. Is this EWMP demonstrably inappropriate for implementation by the water supplier?

( ) Yes (●) No

Details:

Please see response to A.

C. Is this EWMP technically infeasible given current technology or prevailing local conditions?

( ) Yes (●) No

Details:

Please see response to A.

EWMP 7. Construct/Operate Tailwater and Spill Recovery System

Part 7. Summary of Analysis

Initial Evaluation Table (from Part 1)

EWMP	Yes	No
Fully implemented?	**X**	
Demonstrably Inappropriate?		**X**
Technically Infeasible?		**X**

EWMP 7. Construct/Operate Tailwater and Spill Recovery System

Part 7. Summary of Analysis

Potential Environmental Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Source of supply				
B	Confined/Unconfined Groundwater Levels				
C	Shallow Groundwater Elevations				
D	Instream Flows				
E	Drain Flows				
F	Fertilizer / Herbicide / Pesticide Use				
G	Soil Erosion				
H	Field Burning and Fugitive Dust				
I	Energy Use				
J1	Vernal Pools and Swales				
J2	Riparian Habitat				
J3	Open Water Bodies				
J4	Marshes (permanent or seasonal)				

EWMP 7. Construct/Operate Tailwater and Spill Recovery System

Part 7. Summary of Analysis

Potential Third-Party Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Confined/Unconfined Groundwater Levels				
B	Instream Flows				
C	Drain Flows				
D	Fertilizer / Herbicide / Pesticide Use				
E	Wind/Water Soil Erosion				

Indirect Economic Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
B	Farm Inputs				
C	Local farm Labor				
D	Processing of Farm Products				

EWMP 7. Construct/Operate Tailwater and Spill Recovery System

Part 7. Summary of Analysis

EWMP Economic Analysis (from Part 5)

Water Supplier B/C Ratio	

EWMP Financial Analysis (from Part 6)

	Yes	No
Can adequate funding be expected to be made available?	○	○

EWMP 7. Construct/Operate Tailwater and Spill Recovery System

Part 7. Summary of Analysis

Decision about EWMP

	Yes	No
Is this EWMP accepted?	◉	○

Discussion:

Please provide here and in the WMP a discussion of why the EWMP is accepted or rejected for implementation. Please include a discussion of estimated water savings, environmental effects, third-party effects, etc. for this EWMP.

SSWD believes it has implemented this EWMP to a satisfactory level as
individual water users capture tailwater internally to the District, which
results in insignificant quantities of water that spill at the end of its system.
Therefore, SSWD believes that there is no further opportunity to capture
tailwater. However, to support the belief, EWMP #10 would aid to understand
the quantity of tailwater discharging from the system. The estimated timeline and
budget to complete an investigation and summary package for these EWMPs are
detailed in the WMP. Further detail is described under EWMP #10.

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in California

Efficient Water Management Practice (EWMP)

8. Optimize Conjunctive Use

The Excel Version
prepared by Division of Planning and Local Assistance
Department of Water Resources
October 21, 1998

EWMP 8. Optimize Conjunctive Use

PREVIEW - REVIEW

Part 1 Information to Determine if Detailed Analysis is Required

Question A	*(Is EWMP satisfactorily implemented?)*	Yes
Question B	*(Is EWMP demonstrably inappropriate?)*	No
Question C	*(Is EWMP technically infeasible?)*	No

Part 2 Detailed Analysis for EWMPs 1, 2, 3, and 4 (not applicable)

Part 3 General Information for Detailed Analysis

Question A	*(Does EWMP impact other EWMPs?)*	
Question B	*(Matrix information about water supply)*	n/a
Question C	*(Description of programs)*	n/a

Part 4 Environmental, Third Party, and Indirect Economic Analysis

Environmental Effects

Question A	*(On source of supply)*	
Question B	*(On groundwater levels)*	
Question C	*(On shallow groundwater)*	
Question D	*(On instream flows)*	
Question E	*(On drain flows)*	
Question F	*(On herbicide/pesticide use)*	n/a
Question G	*(On soil erosion)*	
Question H	*(On field burning/fugitive dust)*	n/a
Question I	*(On energy use)*	
Question J	*(On habitats)*	n/a

EWMP 8. Optimize Conjunctive Use

Third-Party Effects

Question A	*(On groundwater levels)*	
Question B	*(On instream flows)*	
Question C	*(On drain flows)*	
Question D	*(On herbicide/pesticide use)*	**n/a**
Question E	*(On wind/water soil erosion)*	

Indirect Economic Effects

Question A	*(On local economies via farm operations)*	
Question B	*(On farmers' purchases of crop inputs)*	
Question C	*(On hiring of local farm workers)*	
Question D	*(On local processing of farm produce)*	

Part 5 Economic Analysis

Question A	*(Estimated annual conserved water)*		**af**
Question B	*(Would EWMP result in capital costs?)*		
Question C	*(Would EWMP reduce water purchases?)*		
Question D	*(Would EWMP delay future projects?)*		
Question E	*(Would EWMP increase water sales?)*		

Part 6 Financial Analysis

Adequate funding available?

Part 7 Summary of Analysis

Benefit-Cost Ratio

Accept EWMP? **Yes**

EWMP 8. Optimize Conjunctive Use

Part 1. Information to Determine if Detailed Analysis Is Required

A. Is this EWMP being implemented at a satisfactory level?

(●) Yes ( ) No

Details:

Camp Far West Reservoir was constructed to increase the conjuntive use operation within the District and thereby reduce groundwater extraction and provide in-lieu groundwater recharge by supplying water users with a partial surface water supply. In each year, SSWD allocates a partial suface water supply to water users, which is supplemented with groundwater supplies pumped by individual water users. SSWD continues to seek opportunities to increase surface water deliveries; an example of which is the current project to increase diversion efficiency throught the main canal. Data from EWMP #10 will aid to understand the possibility of further utilizing surface water supplies. Therefore, SSWD believes that this EWMP is implemented to a satisfactory level.

B. Is this EWMP demonstrably inappropriate for implementation by the water supplier?

( ) Yes (●) No

Details:

Please see response to A.

C. Is this EWMP technically infeasible given current technology or prevailing local conditions?

( ) Yes (●) No

Details:

Please see response to A.

EWMP 8. Optimize Conjunctive Use

Part 7. Summary of Analysis

Initial Evaluation Table (from Part 1)

EWMP	Yes	No
Fully implemented?	**X**	
Demonstrably Inappropriate?		**X**
Technically Infeasible?		**X**

EWMP 8. Optimize Conjunctive Use

Part 7. Summary of Analysis

Potential Environmental Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Source of supply				
B	Confined/Unconfined Groundwater Levels				
C	Shallow Groundwater Elevations				
D	Instream Flows				
E	Drain Flows				
F	Fertilizer / Herbicide / Pesticide Use				
G	Soil Erosion				
H	Field Burning and Fugitive Dust				
I	Energy Use				
J1	Vernal Pools and Swales				
J2	Riparian Habitat				
J3	Open Water Bodies				
J4	Marshes (permanent or seasonal)				

EWMP 8. Optimize Conjunctive Use

Part 7. Summary of Analysis

Potential Third-Party Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Confined/Unconfined Groundwater Levels				
B	Instream Flows				
C	Drain Flows				
D	Fertilizer / Herbicide / Pesticide Use				
E	Wind/Water Soil Erosion				

Indirect Economic Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
B	Farm Inputs				
C	Local farm Labor				
D	Processing of Farm Products				

EWMP 8. Optimize Conjunctive Use

Part 7. Summary of Analysis

EWMP Economic Analysis (from Part 5)

Water Supplier B/C Ratio	

EWMP Financial Analysis (from Part 6)

	Yes	**No**
Can adequate funding be expected to be made available?	○	○

EWMP 8. Optimize Conjunctive Use

Part 7. Summary of Analysis

Decision about EWMP

	Yes	No
Is this EWMP accepted?	◉	○

Discussion:

Please provide here and in the WMP a discussion of why the EWMP is accepted or rejected for implementation. Please include a discussion of estimated water savings, environmental effects, third-party effects, etc. for this EWMP.

Camp Far West Reservoir was constructed to increase the conjuntive use
operation within the District and thereby reduce groundwater extraction and
provide in-lieu groundwater recharge by supplying water users with a partial
surface water supply. In each year, SSWD allocates a partial suface water
supply to water users, which is supplemented with groundwater supplies
pumped by individual water users. SSWD continues to seek opportunities to
increase surface water deliveries; an example of which is the current project
to increase diversion efficiency throught the main canal. Data from
EWMP #10 will aid to understand the possibility of further utilizing surface
water supplies. Therefore, SSWD believes that this EWMP is implemented
to a satisfactory level.

Memorandum of Understanding Regarding Efficient Water Management Practices by Agricultural Water Suppliers in California

Efficient Water Management Practice (EWMP)

9. Automate Canal Structures

The Excel Version
prepared by Division of Planning and Local Assistance
Department of Water Resources
October 21, 1998

EWMP 9. Automate Canal Structures

PREVIEW - REVIEW

Part 1 Information to Determine if Detailed Analysis is Required

Question A	*(Is EWMP satisfactorily implemented?)*	No
Question B	*(Is EWMP demonstrably inappropriate?)*	No
Question C	*(Is EWMP technically infeasible?)*	No

Part 2 Detailed Analysis for EWMPs 1, 2, 3, and 4 (not applicable)

Part 3 General Information for Detailed Analysis

Question A	*(Does EWMP impact other EWMPs?)*	Yes
Question B	*(Matrix information about distribution)*	n/a
Question C	*(Description of potential canal system)*	n/a
Question D	*(Was EWMP considered along with others?)*	Yes

Part 4 Environmental, Third Party, and Indirect Economic Analysis

Environmental Effects

Question A	*(On source of supply)*	Insignificant
Question B	*(On groundwater levels)*	Insignificant
Question C	*(On shallow groundwater)*	n/a
Question D	*(On instream flows)*	Insignificant
Question E	*(On drain flows)*	Insignificant
Question F	*(On herbicide/pesticide use)*	n/a
Question G	*(On soil erosion)*	Indeterminate
Question H	*(On field burning/fugitive dust)*	n/a
Question I	*(On energy use)*	Indeterminate
Question J	*(On habitats)*	n/a

EWMP 9. Automate Canal Structures

Third-Party Effects

Question A	(On groundwater levels)	Insignificant
Question B	(On instream flows)	Insignificant
Question C	(On drain flows)	Insignificant
Question D	(On herbicide/pesticide use)	n/a
Question E	(On wind/water soil erosion)	Indeterminate

Indirect Economic Effects

Question A	(On local economies via farm operations)	Insignificant
Question B	(On farmers' purchases of crop inputs)	Insignificant
Question C	(On hiring of local farm workers)	Insignificant
Question D	(On local processing of farm produce)	Insignificant

Part 5 Economic Analysis

Question A	(Estimated annual conserved water)	0 af
Question B	(Would EWMP result in capital costs?)	Unknown
Question C	(Would EWMP reduce water purchases?)	Unknown
Question D	(Would EWMP delay future projects?)	Unknown
Question E	(Would EWMP increase water sales?)	Unknown

Part 6 Financial Analysis

Adequate funding available?

Part 7 Summary of Analysis

Benefit-Cost Ratio	#DIV/0!
Accept EWMP?	Yes

EWMP 9. Automate Canal Structures

Part 1. Information to Determine if Detailed Analysis Is Required

A. Is this EWMP being implemented at a satisfactory level?

○ Yes ◉ No

B. Is this EWMP demonstrably inappropriate for implementation by the water supplier?

○ Yes ◉ No

C. Is this EWMP technically infeasible given current technology or prevailing local conditions?

○ Yes ◉ No

EWMP 9. Automate Canal Structures

Part 3. General Information for Detailed Analysis

A. Does this EWMP impact any of the other EWMPs on List B and/or List C?

◉ Yes ○ No

Discussion:

This EWMP will potentially impact EWMP's #6 and #10. A desired outcome of implementing this EWMP is an increase in water delivery flexibility (EWMP #6). EWMP's #9 and #10 are interrelated whereby implementing one may affect the other and visa versa. Flow measurement technologies are likely to be deployed with the canal control structures, thereby impacting EWMP #10 by increasing the number of flow measurement sites to provide the District with the additional data necessary to operate the automated system. The results from EWMP #10 will aid in the determination of particular automated canal control structures (if any), which must naturally be evaluated before satisfactorily implementing EWMP #9.

B. Please complete the following matrix.

(The matrix is on the next page.)

C. Please attach a description of the potential automated canal structure system. Include in this description: number and types of canal structures to be used; estimated project life span; estimated potential annual water savings (acre-feet); and how those savings were estimated. Also briefly discuss whether other variations of the project were considered.

The results from EWMP #10 must be evaluated before estimating the potential automated canal control structure locations and descriptions. The potential water savings are estimated to be insignificant as the District currently operates to reduce tail water.

D. Was this EWMP considered in coordination with any other EWMPs or other neighboring water suppliers?

◉ Yes ○ No

Discussion:

Considered in coordination with EWMP #6 to increase water delivery flexibility.

EWMP 9. Automate Canal Structures

Part 3. General Information for Detailed Analysis

Question B (Matrix about Automated Locations)

Number of locations within the distribution system which are automated	**1**
Estimate the number of locations within the distribution system which could potentially be automated	**?**

EWMP 9. Automate Canal Structures

Part 4. Environmental, Third-Party, & Indirect Economic Analysis

Environmental Effects

A. Source of Supply

Will implementation of the EWMP result in reduced water demand in the water supplier's service area?

○ Yes ◉ No ○ Unknown

What will be the potential impact?

○ Beneficial ○ Negative ◉ Insignificant ○ Indeterminate

B. Confined/Unconfined Ground Water Levels

Are there any habitats in the water service area that are supported/supplied by the existing groundwater levels?

○ Yes ◉ No ○ Unknown

What will be the potential impact?

○ Beneficial ○ Negative ◉ Insignificant ○ Indeterminate

Discussion:

Implementation of EWMP #9 will not result in significantly reduced groundwater diversions as the demand within the District is not expected to decrease.

C. Shallow Groundwater

(not applicable)

D. Instream Flows

Does the water supplier's distribution system contribute to flows in any other water courses?

(●) Yes	( ) No	( ) Unknown

Will implementation of the EWMP affect flows to any other water courses?

(●) Yes	( ) No	( ) Neither	( ) Unknown

What will be the potential impact?

( ) Beneficial	( ) Negative	(●) Insignificant	( ) Indeterminate

E. Drain Flows

Does the water supplier's service area have drains that supply or support habitat?

(●) Yes	( ) No	( ) Unknown

Will these drain flows be reduced as a result of practices associated with the EWMP?

( ) Yes	(●) No	( ) Unknown

Do you anticipate that drain water quality will improve or degrade as a result of implementing the EWMP?

( ) Improve	( ) Degrade	(●) Neither	( ) Unknown

What will be the potential impact?

( ) Beneficial	( ) Negative	(●) Insignificant	( ) Indeterminate

F. Fertilizer/Herbicide/Pesticide Use

(not applicable)

G. Soil Erosion

Will implementation of the EWMP reduce the current amount of soil erosion in the water supplier service area?

○ Yes ○ No ◉ Unknown

What will be the potential impact?

○ Beneficial ○ Negative ○ Insignificant ◉ Indeterminate

H. Field Burning and/or Fugitive Dust

(not applicable)

I. Energy Use

Would this EWMP increase or decrease energy use (e.g. pump use, canal structure controls, etc.)?

○ Decrease ○ Increase ○ Neither ◉ Unknown

What will be the potential impact?

○ Beneficial ○ Negative ○ Insignificant ◉ Indeterminate

J. Habitat Effect

(not applicable)

EWMP 9. Automate Canal Structures

Part 4. Environmental, Third-Party, & Indirect Economic Analysis (continued)

Third-Party Effects

A. Confined/Unconfined Ground Water Levels

Will implementation of the EWMP affect groundwater elevations?

- (●) Yes ( ) No ( ) Unknown

What will be the potential impact?

- ( ) Beneficial ( ) Negative (●) Insignificant ( ) Indeterminate

B. Instream Flows

Do the water supplier's distribution flows contribute to any natural streams?

- (●) Yes ( ) No ( ) Unknown

Will implementation of the EWMP decrease or increase instream flows to any streams that supply or support any third-party?

- ( ) Increase ( ) Decrease (●) Neither ( ) Unknown

What will be the potential impact?

- ( ) Beneficial ( ) Negative (●) Insignificant ( ) Indeterminate

C. Drain Flows

Do drain flows supply or support any third-party user?

- (●) Yes ( ) No

Do you anticipate that drain water conditions will be affected as a result of implementation of the EWMP?

- (●) Yes ( ) No ( ) Unknown

What will be the potential impact?

- ( ) Beneficial ( ) Negative (●) Insignificant ( ) Indeterminate

D. Herbicide/Pesticide Use
(not applicable)

E. Wind/Water Soil Erosion
Will implementation of the EWMP reduce the current amount of soil erosion in the water supplier service area?

○ Yes ○ No ◉ Unknown

What will be the potential impact?

○ Beneficial ○ Negative ○ Insignificant ◉ Indeterminate

EWMP 9. Automate Canal Structures

Part 4. Environmental, Third-Party, & Indirect Economic Analysis (continued)

Indirect Economic Effects

A. Effects on local economies

Will the EWMP affect local economies through changes in on-farm operations (indirect economic effects)?

○ Yes	● No	○ Unknown

What will be the potential impact?

○ Beneficial	○ Negative	● Insignificant	○ Indeterminate

B. Effects on farmers' purchases of crop inputs

Will practices associated with implementation of the EWMP increase or decrease farmers' purchases of crop inputs such as seed, fertilizer, irrigation equipment, etc.?

○ Increase	○ Decrease	● Neither	○ Unknown

What will be the potential impact?

○ Beneficial	○ Negative	● Insignificant	○ Indeterminate

C. Effects on local employment

Will practices associated with implementation of the EWMP increase or decrease the hiring of local (county) farm workers?

○ Increase	○ Decrease	● Neither	○ Unknown

What will be the potential impact?

○ Beneficial	○ Negative	● Insignificant	○ Indeterminate

D. Effects on local processing of farm produce

Will practices associated with implementation of the EWMP increase or decrease the local (county) processing of farm produce (examples-canning of nuts, fruits, and vegetables; milk production supported by cows/pasture; etc.?

○ Increase	○ Decrease	◉ Neither	○ Unknown

What will be the potential impact?

○ Beneficial	○ Negative	◉ Insignificant	○ Indeterminate

EWMP 9. Automate Canal Structures

Part 4. Tables of Effects Summary

Table 2. Potential Environmental Effects Summary

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Source of supply			X	
B	Confined/Unconfined Groundwater Levels			X	
C	Shallow Groundwater Elevations				
D	Instream Flows			X	
E	Drain Flows			X	
F	Fertilizer / Herbicide / Pesticide Use				
G	Soil Erosion				X
H	Field Burning and Fugitive Dust				
I	Energy Use				X
J1	Vernal Pools and Swales				
J2	Riparian Habitat				
J3	Open Water Bodies				
J4	Marshes (permanent or seasonal)				

EWMP 9. Automate Canal Structures

Part 4. Tables of Effects Summary

Table 3. Potential Third-Party Effects Summary

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Confined/Unconfined Groundwater Levels			X	
B	Instream Flows			X	
C	Drain Flows			X	
D	Fertilizer / Herbicide / Pesticide Use				
E	Win/Water Soil Erosion				X

Table 4. Indirect Economic Effects Summary

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
B	Farm Inputs			X	
C	Local farm Labor			X	
D	Processing of Farm Products			X	

EWMP 9. Automate Canal Structures

Part 5. Economic Analysis

A. How much water (in acre-feet) is estimated to be conserved annually as a result of the EWMP?

0

In the box below please discuss your assumptions and methodology for deriving this estimate.

The objective of implementing this EWMP is to increase water delivery
flexibility. SSWD is committed to evalute the potential of satisfactorily
implementing this EWMP after evaluation of data collected from EWMP #10.

B. Does the EWMP result in water supplier capital costs and/or annual operation and maintenance costs?

○ Yes ○ No ◉ Unknown

Discussion:

The capital costs (if any) are to be evaluated after drainage data is obtained
and evaluated from the implementation of EWMP #10.

C. Would the EWMP reduce current water supplier water purchases, water diversions, and/or groundwater pumping?

○ Yes ○ No ◉ Unknown

D. Would the EWMP delay or eliminate the need to complete future water supply augmentation and/or distribution projects?

○ Yes ○ No ◉ Unknown

E. Would the EWMP result in additional sales of water supplies to existing customers, new customers, and/or other agencies?

○ Yes ○ No ◉ Unknown

Which alternative is to be selected as benefit measure? Please explain in the box below.

No alternative measures are evaluated.

EWMP 9. Automate Canal Structures

Part 5. Economic Analysis (Worksheets)

Worksheet 1. EWMP Water Supplier Effects

Estimated amount of water conserved annually:	0	acre foot

EWMP 9. Automate Canal Structures

Part 5. Economic Analysis (Worksheets)

Worksheet 2. EWMP Water Supplier Costs

Worksheet 2a. EWMP Water Supplier Capital Costs

Complete the following worksheet for EWMP capital costs.

Capital Cost Category	Item	Cost	Contingency Cost		Subtotal
			Percent	Dollars	
(a)	(b)	(c)	(d)	(e)	(f)
				(c x d)	(c + e)
Planning			15%		
Land			15%		
			15%		
Structure			15%		
			15%		
Equipment			15%		
			15%		
Mitigation			15%		
Other			15%		
Subtotal Capital Costs					0
Deduct Expected Salvage Value after		25	years		0
Total Capital Costs					0
Capital Recovery Factor @		6%	25	years	0.0782
Annual Capital Costs (Total Capital Costs x Capital Recovery Factor)					0

EWMP 9. Automate Canal Structures

Part 5. Economic Analysis (Worksheets)

Worksheet 2b. EWMP Water Supplier Annual O&M Costs

Complete the following worksheet for EWMP annual O&M costs:

Annual Operating Costs	**Annual Maintenance Costs**	**Other Annual Costs** [1]	**Total Annual O & M Costs**
(a)	(b)	(c)	(d)
			(a + b + c)
0		**0**	**0**

[1] Other annual costs not included in O&M, such as annual environmental mitigation costs.

EWMP 9. Automate Canal Structures

Part 5. Economic Analysis (Worksheets)

Worksheet 2c. EWMP Water Supplier Costs/af Summary

Annual Capital Costs	Annual O&M Costs	Total Annual Costs	Annual Conserved Water (af)	Cost/af
(a)	(b)	(c)	(d)	(e)
		(a + b)		(c / d)
0	**0**	**0**	**0**	**#DIV/0!**

EWMP 9. Automate Canal Structures

Part 5. Economic Analysis (Worksheets)

Worksheet 3. EWMP Water Supplier Benefits

Worksheet 3a. EWMP Water Supplier Avoided Costs--Current Sources

Complete the following worksheet for current sources of supply that would be avoided with the implementation of the EWMP.

Sources of Supply Avoided	**Amount of Water (af)**	**Annual O&M Costs ($/af)**	**Sources to Used as Benefit Measure**
(a)	(b)	(c)	(d)
	0		

EWMP 9. Automate Canal Structures

Part 5. Economic Analysis (Worksheets)

Worksheet 3b. EWMP Water Supplier Avoided Costs--Future Sources

Complete the following worksheet for future sources eliminated or delayed because of implementation of the EWMP.

Alternative	Total Capital Costs	Capital Recovery Factor [1]	Annual Capital Costs	Annual O&M Costs	Total Annual Costs	Annual Yield	Cost/af
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
			(b x c)		(d + e)		(f / g)
		0.0782					

[1] For a period of 25 years and 6% discount rate.

EWMP 9. Automate Canal Structures

Part 5. Economic Analysis (Worksheets)

Worksheet 3c. Water Supplier Revenue Effects

Complete the following worksheet:

Parties Purchasing Conserved Water	**Amount of Water (af)**	**Selling Price ($/af)**	**Expected Frequency of Sales (%)** [1]	**Expected Selling Price ($/af)**	**Option Fee ($/af)**	**Total Selling Price ($/af)**
(a)	(b)	(c)	(d)	(e)	(f)	(g)
				(c x d)		(e + f)
	0		100%		0	

[1] During a 25-year analysis period, how many years are water sales expected to occur? For example, water sales to farmers might be expected to occur 90% of the years, whereas the frequency to other agencies might be 50% of the years,

[2] Option fees are paid by a contracting agency to a selling agency to maintain the right of the contracting agency to buy water whenever needed.. Although the water may not be purchased every year, the fee is usually paid every year.

EWMP 9. Automate Canal Structures

Part 5. Economic Analysis (Worksheets)

Worksheet 4. EWMP Water Supplier Benefits/Costs Ratio

Benefits and Costs	
EWMP Benefits ($/af)	
EWMP Costs ($/af)	**#DIV/0!**
Benefit/Cost Ratio	**#DIV/0!**

EWMP 9. Automate Canal Structures

Part 6. EWMP Financial Analysis

A water supplier may claim an exemption if:

"Adequate funds (including funds from other beneficiaries of the plan) are not available, and cannot reasonably be expected to be made available, for implementation of the EWMP during the term of the plan." (MOU, Section 4.02)

If the water supplier is claiming an exemption based upon the lack of available funding, please discuss the reasons for this finding. Please include a copy of your latest financial statement and a list of other potential plan beneficiaries who have been contacted.

The availability of adequate funds will be based upon the estimated total
project cost, should the findings from implemeting EWMP #10 warrant such
an action.

EWMP 9. Automate Canal Structures

Part 7. Summary of Analysis

Initial Evaluation Table (from Part 1)

EWMP	Yes	No
Fully implemented?		**X**
Demonstrably Inappropriate?		**X**
Technically Infeasible?		**X**

EWMP 9. Automate Canal Structures

Part 7. Summary of Analysis

Potential Environmental Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Source of supply			X	
B	Confined/Unconfined Groundwater Levels			X	
C	Shallow Groundwater Elevations				
D	Instream Flows			X	
E	Drain Flows			X	
F	Fertilizer / Herbicide / Pesticide Use				
G	Soil Erosion				X
H	Field Burning and Fugitive Dust				
I	Energy Use				X
J1	Vernal Pools and Swales				
J2	Riparian Habitat				
J3	Open Water Bodies				
J4	Marshes (permanent or seasonal)				

EWMP 9. Automate Canal Structures

Part 7. Summary of Analysis

Potential Third-Party Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Confined/Unconfined Groundwater Levels			**X**	
B	Instream Flows			**X**	
C	Drain Flows			**X**	
D	Fertilizer / Herbicide / Pesticide Use				
E	Wind/Water Soil Erosion				**X**

Indirect Economic Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
B	Farm Inputs			**X**	
C	Local farm Labor			**X**	
D	Processing of Farm Products			**X**	

EWMP 9. Automate Canal Structures

Part 7. Summary of Analysis

EWMP Economic Analysis (from Part 5)

Water Supplier B/C Ratio	**#DIV/0!**

EWMP Financial Analysis (from Part 6)

	Yes	No
Can adequate funding be expected to be made available?	○	○

EWMP 9. Automate Canal Structures

Part 7. Summary of Analysis

Decision about EWMP

	Yes	No
Is this EWMP accepted?	◉	○

Discussion:

Please provide here and in the WMP a discussion of why the EWMP is accepted or rejected for implementation. Please include a discussion of estimated water savings, environmental effects, third-party effects, etc. for this EWMP.

This EWMP is accepted as a part of the WMP for SSWD because implementation may
occur after the District has sufficient time to evaluate data from EWMP #10.
The availability of adequate funds will be based upon the estimated total
project cost, should the findings from implemeting EWMP #10 warrant such
an action. The estimated timeline and budget to complete an investigation and
summary package for the EWMPs are detailed in the WMP.

Memorandum of Understanding
Regarding
Efficient Water Management Practices
by Agricultural Water Suppliers
in California

Efficient Water Management Practice (EWMP)
10. Water Measurement/Water Use Update

The Excel Version
prepared by Division of Planning and Local Assistance
Department of Water Resources
October 21, 1998

PREVIEW - REVIEW

Part 1 Information to Determine if Detailed Analysis is Required (not applicable)

Part 2 Detailed Analysis for EWMPs 1, 2, 3, and 4 (not applicable)

Part 3 General Information for Detailed Analysis

Question	A	*(Does EWMP impact other EWMPs?)*	Yes
Question	B	*(Description of calculation practices)*	n/a
Question	C	*(Was EWMP considered along with others?)*	Yes

Part 4 Environmental, Third Party, and Indirect Economic Analysis

Environmental Effects

Question	A	*(On source of supply)*	Insignificant
Question	B	*(On groundwater levels)*	Insignificant
Question	C	*(On shallow groundwater)*	Insignificant
Question	D	*(On instream flows)*	Insignificant
Question	E	*(On drain flows)*	Insignificant
Question	F	*(On herbicide/pesticide use)*	n/a
Question	G	*(On soil erosion)*	Indeterminate
Question	H	*(On field burning/fugitive dust)*	n/a
Question	I	*(On energy use)*	Insignificant
Question	J	*(On habitats)*	n/a

EWMP 10. Water Measurement/Water Use Update

Third-Party Effects

Question A	*(On groundwater levels)*	Insignificant
Question B	*(On instream flows)*	Insignificant
Question C	*(On drain flows)*	Insignificant
Question D	*(On herbicide/pesticide use)*	n/a
Question E	*(On wind/water soil erosion)*	Indeterminate

Indirect Economic Effects

Question A	*(On local economies via farm operations)*	Insignificant
Question B	*(On farmers' purchases of crop inputs)*	Insignificant
Question C	*(On hiring of local farm workers)*	Insignificant
Question D	*(On local processing of farm produce)*	Insignificant

Part 5 Economic Analysis

Question A	*(Estimated annual conserved water)*	0 af
Question B	*(Would EWMP result in capital costs?)*	Unknown
Question C	*(Would EWMP reduce water purchases?)*	Unknown
Question D	*(Would EWMP delay future projects?)*	Unknown
Question E	*(Would EWMP increase water sales?)*	Unknown

Part 6 Financial Analysis

Adequate funding available?	

Part 7 Summary of Analysis

Benefit-Cost Ratio	#DIV/0!
Accept EWMP?	Yes

EWMP 10. Water Measurement/Water Use Update

Part 3. General Information for Detailed Analysis

A. Does this EWMP impact any of the other EWMPs on List B and/or List C?

◉ Yes ○ No

Discussion:

EWMP #10 impacts EWMP's #6, #7, #8, and #9. Flow measurement at spill locations within SSWD will provide the necessary data to evaluate management practices and opportunities to conserve water related to activities activities associated with the aforementioned EWMPs. The results of the data evaluation are unknown (as a plan for data collection has yet to be developed) and therefore the impacts to the other identified EWMPs are similarly unknown.

B. Please describe the current and/or proposed water measurement/calculation practices. The description should include measurement/calculation of volume of water delivered within a reasonable range of accuracy. The description may be based on deliveries to individual water users or other reasonable measurement options

Discussion:

SSWD measures water to individual users through a variety of methods depending upon the method of diversion; gravity, pumped from canal or drain, or diverted through the Bear River Drive Pipeline. These flow measurements are gathered from propeller flow meters and water level data using a theoretical rating for a weir structure. The equipment was calibrated before or at the time of installation and is estimated to provide a flow rate of within +/- 10% of the actual flow rate. Recalibration of these measurement devices will depend on the funding available. SSWD intends to measure the quantity of water leaving the District to evaluate the potential benefits of other EWMPs as described in (A). The method(s) by which the latter data will be obtained is yet unknown.

C. Was this EWMP considered in coordination with any other EWMPs or other neighboring water suppliers?

◉ Yes ○ No

Discussion:

EWMP #10 is considered in coordination with EWMP's #7, #8, and #9.

Part 4. Environmental, Third-Party, & Indirect Economic Analysis

Environmental Effects

A. Source of Supply

Will implementation of the EWMP result in reduced water demand in the water supplier's service area?

○ Yes ◉ No ○ Unknown

What will be the potential impact?

○ Beneficial ○ Negative ◉ Insignificant ○ Indeterminate

B. Confined/Unconfined Ground Water Levels

Are there any habitats in the water service area that are supported/supplied by the existing groundwater levels?

○ Yes ◉ No ○ Unknown

What will be the potential impact?

○ Beneficial ○ Negative ◉ Insignificant ○ Indeterminate

Discussion:

EWMP #10 will not result in significantly reduced groundwater diversions as the demand within the District is not expected to decrease.

C. Shallow Groundwater

Is the water supplier located in an area where shallow groundwater and/or water quality problems (i.e. salinity, selenium) limit the use of land and/or drainage water?

○ Yes ◉ No ○ Unknown

What will be the potential impact?

○ Beneficial ○ Negative ◉ Insignificant ○ Indeterminate

D. Instream Flows

Does the water supplier's distribution system contribute to flows in any other water courses?

- (●) Yes ( ) No ( ) Unknown

Will implementation of the EWMP affect flows to any other water courses?

- (●) Yes ( ) No ( ) Neither ( ) Unknown

What will be the potential impact?

- ( ) Beneficial ( ) Negative (●) Insignificant ( ) Indeterminate

E. Drain Flows

Does the water supplier's service area have drains that supply or support habitat?

- (●) Yes ( ) No ( ) Unknown

Will these drain flows be reduced as a result of practices associated with the EWMP?

- ( ) Yes (●) No ( ) Unknown

Do you anticipate that drain water quality will improve or degrade as a result of implementing the EWMP?

- ( ) Improve ( ) Degrade (●) Neither ( ) Unknown

What will be the potential impact?

- ( ) Beneficial ( ) Negative (●) Insignificant ( ) Indeterminate

F. Fertilizer/Herbicide/Pesticide Use

(not applicable)

G. Soil Erosion

Will implementation of the EWMP reduce the current amount of soil erosion in the water supplier service area?

- ( ) Yes ( ) No (●) Unknown

What will be the potential impact?

- ( ) Beneficial ( ) Negative ( ) Insignificant (●) Indeterminate

H. Field Burning and/or Fugitive Dust

(not applicable)

I. Energy Use

Would this EWMP increase or decrease energy use (e.g. pump use, canal structure controls, etc.)?

○ Decrease	○ Increase	◉ Neither	○ Unknown

What will be the potential impact?

○ Beneficial	○ Negative	◉ Insignificant	○ Indeterminate

J. Habitat Effect

(not applicable)

EWMP 10. Water Measurement/Water Use Update

Part 4. Environmental, Third-Party, & Indirect Economic Analysis (continued)

Third-Party Effects

A. Confined/Unconfined Ground Water Levels

Will implementation of the EWMP affect groundwater elevations?

(•) Yes ( ) No ( ) Unknown

What will be the potential impact?

( ) Beneficial ( ) Negative (•) Insignificant ( ) Indeterminate

B. Instream Flows

Do the water supplier's distribution flows contribute to any natural streams?

(•) Yes ( ) No ( ) Unknown

Will implementation of the EWMP decrease or increase instream flows to any streams that supply or support any third-party?

( ) Increase ( ) Decrease (•) Neither ( ) Unknown

What will be the potential impact?

( ) Beneficial ( ) Negative (•) Insignificant ( ) Indeterminate

C. Drain Flows

Do drain flows supply or support any third-party user?

(•) Yes ( ) No

Do you anticipate that drain water conditions will be affected as a result of implementation of the EWMP?

(•) Yes ( ) No ( ) Unknown

What will be the potential impact?

( ) Beneficial ( ) Negative (•) Insignificant ( ) Indeterminate

D. Herbicide/Pesticide Use

(not applicable)

E. Wind/Water Soil Erosion

Will implementation of the EWMP reduce the current amount of soil erosion in the water supplier service area?

○ Yes	○ No	◉ Unknown

What will be the potential impact?

○ Beneficial	○ Negative	○ Insignificant	◉ Indeterminate

EWMP 10. Water Measurement/Water Use Update

Part 4. Environmental, Third-Party, & Indirect Economic Analysis (continued)

Indirect Economic Effects

A. Effects on local economies
Will the EWMP affect local economies through changes in on-farm operations (indirect economic effects)?

○ Yes ◉ No ○ Unknown

What will be the potential impact?

○ Beneficial ○ Negative ◉ Insignificant ○ Indeterminate

B. Effects on farmers' purchases of crop inputs
Will practices associated with implementation of the EWMP increase or decrease farmers' purchases of crop inputs such as seed, fertilizer, irrigation equipment, etc.?

○ Increase ○ Decrease ◉ Neither ○ Unknown

What will be the potential impact?

○ Beneficial ○ Negative ◉ Insignificant ○ Indeterminate

C. Effects on local employment
Will practices associated with implementation of the EWMP increase or decrease the hiring of local (county) farm workers?

○ Increase ○ Decrease ◉ Neither ○ Unknown

What will be the potential impact?

○ Beneficial ○ Negative ◉ Insignificant ○ Indeterminate

D. Effects on local processing of farm produce

Will practices associated with implementation of the EWMP increase or decrease the local (county) processing of farm produce (examples-canning of nuts, fruits, and vegetables; milk production supported by cows/pasture; etc.?

○ Increase	○ Decrease	◉ Neither	○ Unknown

What will be the potential impact?

○ Beneficial	○ Negative	◉ Insignificant	○ Indeterminate

EWMP 10. Water Measurement/Water Use Update

Part 4. Tables of Effects Summary

Table 2. Potential Environmental Effects Summary

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Source of supply			X	
B	Confined/Unconfined Groundwater Levels			X	
C	Shallow Groundwater Elevations			X	
D	Instream Flows			X	
E	Drain Flows			X	
F	Fertilizer / Herbicide / Pesticide Use				
G	Soil Erosion				X
H	Field Burning and Fugitive Dust				
I	Energy Use			X	
J1	Vernal Pools and Swales				
J2	Riparian Habitat				
J3	Open Water Bodies				
J4	Marshes (permanent or seasonal)				

EWMP 10. Water Measurement/Water Use Update

Part 4. Tables of Effects Summary

Table 3. Potential Third-Party Effects Summary

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Confined/Unconfined Groundwater Levels			X	
B	Instream Flows			X	
C	Drain Flows			X	
D	Fertilizer / Herbicide / Pesticide Use				
E	Win/Water Soil Erosion				X

Table 4. Indirect Economic Effects Summary

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
B	Farm Inputs			X	
C	Local farm Labor			X	
D	Processing of Farm Products			X	

EWMP 10. Water Measurement/Water Use Update

Part 5. Economic Analysis

A. How much water (in acre-feet) is estimated to be conserved annually as a result of the EWMP?

0

In the box below please discuss your assumptions and methodology for deriving this estimate.

NEED

B. Does the EWMP result in water supplier capital costs and/or annual operation and maintenance costs?

○ Yes ○ No ◉ Unknown

Discussion:

Water supplier costs are not evaluated pending a water measurement strategy for the District. The plan will reveal capital costs and associated annual operation and maintenance costs.

C. Would the EWMP reduce current water supplier water purchases, water diversions, and/or groundwater pumping?

○ Yes ○ No ◉ Unknown

D. Would the EWMP delay or eliminate the need to complete future water supply augmentation and/or distribution projects?

○ Yes ○ No ◉ Unknown

E. Would the EWMP result in additional sales of water supplies to existing customers, new customers, and/or other agencies?

○ Yes ○ No ◉ Unknown

Which alternative is to be selected as benefit measure? Please explain in the box below.

No alternatives are evaluated.

EWMP 10. Water Measurement/Water Use Update

Part 5. Economic Analysis (Worksheets)

Worksheet 1. EWMP Water Supplier Effects

Estimated amount of water conserved annually: 0 acre foot

EWMP 10. Water Measurement/Water Use Update

Part 5. Economic Analysis (Worksheets)

Worksheet 2. EWMP Water Supplier Costs

Worksheet 2a. EWMP Water Supplier Capital Costs

Complete the following worksheet for EWMP capital costs.

Capital Cost Category	Item	Cost	Contingency Cost		Subtotal
			Percent	Dollars	
(a)	(b)	(c)	(d)	(e)	(f)
				(c x d)	(c + e)
Planning			15%		
Land			15%		
			15%		
Structure			15%		
			15%		
Equipment			15%		
			15%		
Mitigation			15%		
Other			15%		
Subtotal Capital Costs					0
Deduct Expected Salvage Value after		25	years		0
Total Capital Costs					0
Capital Recovery Factor @		6%	25	years	0.0782
Annual Capital Costs (Total Capital Costs x Capital Recovery Factor)					0

EWMP 10. Water Measurement/Water Use Update

Part 5. Economic Analysis (Worksheets)

Worksheet 2b. EWMP Water Supplier Annual O&M Costs

Complete the following worksheet for EWMP annual O&M costs:

Annual Operating Costs	Annual Maintenance Costs	Other Annual Costs [1]	Total Annual O & M Costs
(a)	(b)	(c)	(d)
			(a + b + c)
0		0	0

[1] Other annual costs not included in O&M, such as annual environmental mitigation costs.

EWMP 10. Water Measurement/Water Use Update

Part 5. Economic Analysis (Worksheets)

Worksheet 2c. EWMP Water Supplier Costs/af Summary

Annual Capital Costs	Annual O&M Costs	Total Annual Costs	Annual Conserved Water (af)	Cost/af
(a)	(b)	(c)	(d)	(e)
		(a + b)		(c / d)
0	**0**	**0**	**0**	**#DIV/0!**

EWMP 10. Water Measurement/Water Use Update

Part 5. Economic Analysis (Worksheets)

Worksheet 3. EWMP Water Supplier Benefits

Worksheet 3a. EWMP Water Supplier Avoided Costs--Current Sources

Complete the following worksheet for current sources of supply that would be avoided with the implementation of the EWMP.

Sources of Supply Avoided	**Amount of Water (af)**	**Annual O&M Costs ($/af)**	**Sources to Used as Benefit Measure**
(a)	(b)	(c)	(d)
	0		

EWMP 10. Water Measurement/Water Use Update

Part 5. Economic Analysis (Worksheets)

Worksheet 3b. EWMP Water Supplier Avoided Costs--Future Sources

Complete the following worksheet for future sources eliminated or delayed because of implementation of the EWMP.

Alternative	Total Capital Costs	Capital Recovery Factor [1]	Annual Capital Costs	Annual O&M Costs	Total Annual Costs	Annual Yield	Cost/af
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
			(b x c)		(d + e)		(f / g)
		0.0782					

[1] For a period of 25 years and 6% discount rate.

EWMP 10. Water Measurement/Water Use Update

Part 5. Economic Analysis (Worksheets)

Worksheet 3c. Water Supplier Revenue Effects

Complete the following worksheet:

Parties Purchasing Conserved Water	**Amount of Water (af)**	**Selling Price ($/af)**	**Expected Frequency of Sales (%)** [1]	**Expected Selling Price ($/af)**	**Option Fee ($/af)**	**Total Selling Price ($/af)**
(a)	(b)	(c)	(d)	(e)	(f)	(g)
				(c x d)		(e + f)
	0		100%		0	

[1] During a 25-year analysis period, how many years are water sales expected to occur? For example, water sales to farmers might be expected to occur 90% of the years, whereas the frequency to other agencies might be 50% of the years,

[2] Option fees are paid by a contracting agency to a selling agency to maintain the right of the contracting agency to buy water whenever needed.. Although the water may not be purchased every year, the fee is usually paid every year.

EWMP 10. Water Measurement/Water Use Update

Part 5. Economic Analysis (Worksheets)

Worksheet 4. EWMP Water Supplier Benefits/Costs Ratio

Benefits and Costs	
EWMP Benefits ($/af)	
EWMP Costs ($/af)	**#DIV/0!**
Benefit/Cost Ratio	**#DIV/0!**

EWMP 10. Water Measurement/Water Use Update

Part 6. EWMP Financial Analysis

A water supplier may claim an exemption if:

"Adequate funds (including funds from other beneficiaries of the plan) are not available, and cannot reasonably be expected to be made available, for implementation of the EWMP during the term of the plan." (MOU, Section 4.02)

If the water supplier is claiming an exemption based upon the lack of available funding, please discuss the reasons for this finding. Please include a copy of your latest financial statement and a list of other potential plan beneficiaries who have been contacted.

EWMP 10. Water Measurement/Water Use Update

Part 7. Summary of Analysis

Potential Environmental Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Source of supply			X	
B	Confined/Unconfined Groundwater Levels			X	
C	Shallow Groundwater Elevations			X	
D	Instream Flows			X	
E	Drain Flows			X	
F	Fertilizer / Herbicide / Pesticide Use				
G	Soil Erosion				X
H	Field Burning and Fugitive Dust				
I	Energy Use			X	
J1	Vernal Pools and Swales				
J2	Riparian Habitat				
J3	Open Water Bodies				
J4	Marshes (permanent or seasonal)				

EWMP 10. Water Measurement/Water Use Update

Part 7. Summary of Analysis

Potential Third-Party Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Confined/Unconfined Groundwater Levels			X	
B	Instream Flows			X	
C	Drain Flows			X	
D	Fertilizer / Herbicide / Pesticide Use				
E	Wind/Water Soil Erosion				X

Indirect Economic Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
B	Farm Inputs			X	
C	Local farm Labor			X	
D	Processing of Farm Products			X	

EWMP 10. Water Measurement/Water Use Update

Part 7. Summary of Analysis

EWMP Economic Analysis (from Part 5)

Water Supplier B/C Ratio	**#DIV/0!**

EWMP Financial Analysis (from Part 6)

	Yes	No
Can adequate funding be expected to be made available?	○	○

EWMP 10. Water Measurement/Water Use Update

Part 7. Summary of Analysis

Decision about EWMP

	Yes	No
Is this EWMP accepted?	◉	○

Discussion:

Please provide here and in the WMP a discussion of why the EWMP is accepted or rejected for implementation. Please include a discussion of estimated water savings, environmental effects, third-party effects, etc. for this EWMP.

SSWD measures water to individual users through a variety of methods depending upon the method of diversion; gravity, pumped from canal or drain, or diverted through the Bear River Drive Pipeline. These flow measurements are gathered from propeller flow meters and water level data using a theoretical rating for a weir structure. The equipment was calibrated before or at the time of installation and is estimated to provide a flow rate of within +/- 10% of the actual flow rate. Recalibration of these measurement devices will depend on the funding available.

SSWD intends to develop a strategy for measuring flows leaving the District. The findings of flow measurement are of course, unknown, and therefore the estimated water savings, environmental effects, and third-party effects are similarly unknown. This EWMP is accepted as a part of the WMP for SSWD; the estimated timeline and budget to complete an investigation and summary package for the EWMPs are detailed in the WMP.

Memorandum of Understanding
Regarding
Efficient Water Management Practices
by Agricultural Water Suppliers
in California

Efficient Water Management Practice (EWMP)

11. Pricing and Incentives

The Excel Version
prepared by Division of Planning and Local Assistance
Department of Water Resources
October 21, 1998

PREVIEW - REVIEW

Part 1 Information to Determine if Detailed Analysis is Required (not applicable)

Part 2 Detailed Analysis for EWMPs 1, 2, 3, and 4 (not applicable)

Part 3 General Information for Detailed Analysis

Question	A	*(Description of objective)*	n/a
Question	Ba1	*(Was tiered water pricing considered?)*	No
Question	Ba2	*(Was wet vs. dry year pricing considered?)*	Yes
Question	Ba3	*(Was uniform block pricing considered?)*	Yes
Question	Ba4	*(Was other pricing considered?)*	No
Question	Bb1	*(Was buy-back program considered?)*	No
Question	Bb2	*(Was low interest loans considered?)*	No
Question	Bb3	*(Was cost sharing considered?)*	No
Question	C	*(Does EWMP impact other EWMPs?)*	No
Question	D	*(Was EWMP considered along with others?)*	No

Part 4 Environmental, Third Party, and Indirect Economic Analysis

Environmental Effects

Question	A	*(On source of supply)*	Insignificant
Question	B	*(On groundwater levels)*	Insignificant
Question	C	*(On shallow groundwater)*	Insignificant
Question	D	*(On instream flows)*	Insignificant
Question	E	*(On drain flows)*	Insignificant
Question	F	*(On herbicide/pesticide use)*	n/a
Question	G	*(On soil erosion)*	Indeterminate
Question	H	*(On field burning/fugitive dust)*	n/a
Question	I	*(On energy use)*	Insignificant
Question	J	*(On habitats)*	n/a

EWMP 11. Pricing and Incentives

Third-Party Effects

Question	A	*(On groundwater levels)*	Insignificant
Question	B	*(On instream flows)*	Insignificant
Question	C	*(On drain flows)*	Insignificant
Question	D	*(On herbicide/pesticide use)*	n/a
Question	E	*(On wind/water soil erosion)*	Indeterminate

Indirect Economic Effects

Question	A	*(On local economies via farm operations)*	Indeterminate
Question	B	*(On farmers' purchases of crop inputs)*	Indeterminate
Question	C	*(On hiring of local farm workers)*	Indeterminate
Question	D	*(On local processing of farm produce)*	Indeterminate

Part 5 Economic Analysis

Question	A	*(Estimated annual conserved water)*	0 af
Question	B	*(Would EWMP result in capital costs?)*	No
Question	C	*(Would EWMP reduce water purchases?)*	Unknown
Question	D	*(Would EWMP delay future projects?)*	Unknown
Question	E	*(Would EWMP increase water sales?)*	Unknown

Part 6 Financial Analysis

Adequate funding available?

Part 7 Summary of Analysis

Benefit-Cost Ratio — #DIV/0!

Accept EWMP? — Yes

EWMP 11. Pricing and Incentives

Part 3. General Information for Detailed Analysis

For a pricing structure to be considered an EWMP, it must encourage the more efficient use of water.

A. Specific Objectives

A clearly defined, specific objective must be established before a pricing incentive procedure is implemented. Please describe the objective.

SSWD's objective is to establish water prices to cover operational costs and to
provide an emergency reserve, while incentivizing water users to use their
entire surface water allotment.

B. Practices

Please identify those pricing and other incentives practices the supplier is considering and those that are currently in place as identified in the EWMP. Has the water supplier considered the following practices?

(a) Pricing

(1) Tiered water pricing (increasing block rates)

○ Yes ◉ No

Discussion:

Maximizing surface water use and tiered water pricing are not compatable.

This practice can set higher prices to penalize users who apply greater amounts of water than is required for crop ET, leaching requirements, and other beneficial uses. Caution must be used to prevent the substitution of groundwater for surface water unless that is the stated objective.

(2) Wet vs. dry year pricing structure

◉ Yes ○ No

Discussion:

Based on the available surface water supply each year, the price structure is
established to cover annual District operation and maintenance costs.
An example of the rate structure is provided in Appendix 2 of the WMP.

(3) Uniform block pricing

◉ Yes ○ No

Discussion:

Costs are dependent upon the specific type of delivery, which results in variable costs to SSWD.

(4) Other

○ Yes ◉ No

(b) Other incentives

(1) Supplier buy-back program

○ Yes ◉ No

Discussion:

SSWD's objective is to maximize surface water deliveries.

If a supplier buys water back from growers, the growers should not substitute groundwater for surface water unless that is an intended purpose.

(2) Low interest loans

○ Yes ◉ No

Discussion:

SSWD is developing a list of available funding sources for its water users in coordination with DWR, which will include low-interest loans.

(3) Cost sharing for on-farm improvements

○ Yes ◉ No

Discussion:

Individual landowners are responsible for on-farm improvements.

Part 3. General Information for Detailed Analysis

C. Does this EWMP impact any of the other EWMPs?

○ Yes ◉ No

D. Was this EWMP considered in coordination with any other EWMPs or other neighboring water suppliers?

○ Yes ◉ No

Part 4. Environmental, Third-Party, & Indirect Economic Analysis

Environmental Effects

A. Source of Supply

Will implementation of the EWMP result in reduced water demand in the water supplier's service area?

○ Yes ◉ No ○ Unknown

What will be the potential impact?

○ Beneficial ○ Negative ◉ Insignificant ○ Indeterminate

B. Confined/Unconfined Ground Water Levels

Are there any habitats in the water service area that are supported/supplied by the existing groundwater levels?

○ Yes ◉ No ○ Unknown

What will be the potential impact?

○ Beneficial ○ Negative ◉ Insignificant ○ Indeterminate

Discussion:

Implementation of EWMP #11 will not result in significantly reduced groundwater diversions as the demand within the district is not expected to decrease.

C. Shallow Groundwater

Is the water supplier located in an area where shallow groundwater and/or water quality problems (i.e. salinity, selenium) limit the use of land and/or drainage water?

○ Yes ◉ No ○ Unknown

What will be the potential impact?

○ Beneficial ○ Negative ◉ Insignificant ○ Indeterminate

D. Instream Flows

Does the water supplier's distribution system contribute to flows in any other water courses?

- (●) Yes ( ) No ( ) Unknown

Will implementation of the EWMP affect flows to any other water courses?

- (●) Yes ( ) No ( ) Neither ( ) Unknown

What will be the potential impact?

- ( ) Beneficial ( ) Negative (●) Insignificant ( ) Indeterminate

E. Drain Flows

Does the water supplier's service area have drains that supply or support habitat?

- (●) Yes ( ) No ( ) Unknown

Will these drain flows be reduced as a result of practices associated with the EWMP?

- ( ) Yes (●) No ( ) Unknown

Do you anticipate that drain water quality will improve or degrade as a result of implementing the EWMP?

- ( ) Improve ( ) Degrade (●) Neither ( ) Unknown

What will be the potential impact?

- ( ) Beneficial ( ) Negative (●) Insignificant ( ) Indeterminate

F. Fertilizer/Herbicide/Pesticide Use

(not applicable)

G. Soil Erosion

Will implementation of the EWMP reduce the current amount of soil erosion in the water supplier service area?

- ( ) Yes ( ) No (●) Unknown

What will be the potential impact?

- ( ) Beneficial ( ) Negative ( ) Insignificant (●) Indeterminate

H. Field Burning and/or Fugitive Dust

(not applicable)

I. Energy Use

Would this EWMP increase or decrease energy use (e.g. pump use, canal structure controls, etc.)?

○ Decrease	○ Increase	◉ Neither	○ Unknown

What will be the potential impact?

○ Beneficial	○ Negative	◉ Insignificant	○ Indeterminate

J. Habitat Effect

(not applicable)

EWMP 11. Pricing and Incentives

Part 4. Environmental, Third-Party, & Indirect Economic Analysis (continued)

Third-Party Effects

A. Confined/Unconfined Ground Water Levels

Will implementation of the EWMP affect groundwater elevations?

(●) Yes	( ) No	( ) Unknown

What will be the potential impact?

( ) Beneficial	( ) Negative	(●) Insignificant	( ) Indeterminate

B. Instream Flows

Do the water supplier's distribution flows contribute to any natural streams?

(●) Yes	( ) No	( ) Unknown

Will implementation of the EWMP decrease or increase instream flows to any streams that supply or support any third-party?

( ) Increase	( ) Decrease	(●) Neither	( ) Unknown

What will be the potential impact?

( ) Beneficial	( ) Negative	(●) Insignificant	( ) Indeterminate

C. Drain Flows

Do drain flows supply or support any third-party user?

- [x] Yes
- [ ] No

Do you anticipate that drain water conditions will be affected as a result of implementation of the EWMP?

- [ ] Yes
- [x] No
- [ ] Unknown

What will be the potential impact?

- [ ] Beneficial
- [ ] Negative
- [x] Insignificant
- [ ] Indeterminate

D. Herbicide/Pesticide Use

(not applicable)

E. Wind/Water Soil Erosion

Will implementation of the EWMP reduce the current amount of soil erosion in the water supplier service area?

- [ ] Yes
- [ ] No
- [x] Unknown

What will be the potential impact?

- [ ] Beneficial
- [ ] Negative
- [ ] Insignificant
- [x] Indeterminate

EWMP 11. Pricing and Incentives

Part 4. Environmental, Third-Party, & Indirect Economic Analysis (continued)

Indirect Economic Effects

A. Effects on local economies

Will the EWMP affect local economies through changes in on-farm operations (indirect economic effects)?

○ Yes ○ No ◉ Unknown

What will be the potential impact?

○ Beneficial ○ Negative ○ Insignificant ◉ Indeterminate

B. Effects on farmers' purchases of crop inputs

Will practices associated with implementation of the EWMP increase or decrease farmers' purchases of crop inputs such as seed, fertilizer, irrigation equipment, etc.?

○ Increase ○ Decrease ○ Neither ◉ Unknown

What will be the potential impact?

○ Beneficial ○ Negative ○ Insignificant ◉ Indeterminate

C. Effects on local employment

Will practices associated with implementation of the EWMP increase or decrease the hiring of local (county) farm workers?

○ Increase ○ Decrease ○ Neither ◉ Unknown

What will be the potential impact?

○ Beneficial ○ Negative ○ Insignificant ◉ Indeterminate

D. Effects on local processing of farm produce

Will practices associated with implementation of the EWMP increase or decrease the local (county) processing of farm produce (examples-canning of nuts, fruits, and vegetables; milk production supported by cows/pasture; etc.?

○ Increase	○ Decrease	○ Neither	◉ Unknown

What will be the potential impact?

○ Beneficial	○ Negative	○ Insignificant	◉ Indeterminate

EWMP 11. Pricing and Incentives

Part 4. Tables of Effects Summary

Table 2. Potential Environmental Effects Summary

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Source of supply			X	
B	Confined/Unconfined Groundwater Levels			X	
C	Shallow Groundwater Elevations			X	
D	Instream Flows			X	
E	Drain Flows			X	
F	Fertilizer / Herbicide / Pesticide Use				
G	Soil Erosion				X
H	Field Burning and Fugitive Dust				
I	Energy Use			X	
J1	Vernal Pools and Swales				
J2	Riparian Habitat				
J3	Open Water Bodies				
J4	Marshes (permanent or seasonal)				

EWMP 11. Pricing and Incentives

Part 4. Tables of Effects Summary

Table 3. Potential Third-Party Effects Summary

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Confined/Unconfined Groundwater Levels			X	
B	Instream Flows			X	
C	Drain Flows			X	
D	Fertilizer / Herbicide / Pesticide Use				
E	Win/Water Soil Erosion				X

Table 4. Indirect Economic Effects Summary

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
B	Farm Inputs				X
C	Local farm Labor				X
D	Processing of Farm Products				X

EWMP 11. Pricing and Incentives

Part 5. Economic Analysis

A. How much water (in acre-feet) is estimated to be conserved annually as a result of the EWMP?

0

In the box below please discuss your assumptions and methodology for deriving this estimate.

SSWD's objective is to maximize surface water deliveries by charging users
a predetermined cost per unit of water, based on the hydrology of the year.
Therefore, there will be no reduction in water use as a result of this EWMP.

B. Does the EWMP result in water supplier capital costs and/or annual operation and maintenance costs?

○ Yes ◉ No ○ Unknown

Discussion:

SSWD is currently providing the users with satisfactory pricing and
incetives by charging an amount to cover annual operational and
maintenance costs and provide for an emergency reserve. Therefore,
there will be an insignificant increase in the annual operation and
maintenance costs related to this EWMP.

C. Would the EWMP reduce current water supplier water purchases, water diversions, and/or groundwater pumping?

○ Yes ○ No ◉ Unknown

D. Would the EWMP delay or eliminate the need to complete future water supply augmentation and/or distribution projects?

○ Yes ○ No ◉ Unknown

E. Would the EWMP result in additional sales of water supplies to existing customers, new customers, and/or other agencies?

○ Yes	○ No	◉ Unknown

Which alternative is to be selected as benefit measure? Please explain in the box below.

No alternatives evaluated.

EWMP 11. Pricing and Incentives

Part 5. Economic Analysis (Worksheets)

Worksheet 1. EWMP Water Supplier Effects

Estimated amount of water conserved annually:	0	acre foot

EWMP 11. Pricing and Incentives

Part 5. Economic Analysis (Worksheets)

Worksheet 2. EWMP Water Supplier Costs

Worksheet 2a. EWMP Water Supplier Capital Costs

Complete the following worksheet for EWMP capital costs.

Capital Cost Category	Item	Cost	Contingency Cost		Subtotal
			Percent	Dollars	
(a)	(b)	(c)	(d)	(e)	(f)
				(c x d)	(c + e)
Planning			15%		
Land			15%		
			15%		
Structure			15%		
			15%		
Equipment			15%		
			15%		
Mitigation			15%		
Other			15%		
Subtotal Capital Costs					0
Deduct Expected Salvage Value after		25	years		0
Total Capital Costs					0
Capital Recovery Factor @		6%	25	years	0.0782
Annual Capital Costs (Total Capital Costs x Capital Recovery Factor)					0

EWMP 11. Pricing and Incentives

Part 5. Economic Analysis (Worksheets)

Worksheet 2b. EWMP Water Supplier Annual O&M Costs

Complete the following worksheet for EWMP annual O&M costs:

Annual Operating Costs	Annual Maintenance Costs	Other Annual Costs [1]	Total Annual O & M Costs
(a)	(b)	(c)	(d)
			(a + b + c)
50,000		0	50,000

[1] Other annual costs not included in O&M, such as annual environmental mitigation costs.

EWMP 11. Pricing and Incentives

Part 5. Economic Analysis (Worksheets)

Worksheet 2c. EWMP Water Supplier Costs/af Summary

Annual Capital Costs	Annual O&M Costs	Total Annual Costs	Annual Conserved Water (af)	Cost/af
(a)	(b)	(c)	(d)	(e)
		(a + b)		(c / d)
0	50,000	50,000	0	#DIV/0!

EWMP 11. Pricing and Incentives

Part 5. Economic Analysis (Worksheets)

Worksheet 3. EWMP Water Supplier Benefits

Worksheet 3a. EWMP Water Supplier Avoided Costs--Current Sources

Complete the following worksheet for current sources of supply that would be avoided with the implementation of the EWMP.

Sources of Supply Avoided	**Amount of Water (af)**	**Annual O&M Costs ($/af)**	**Sources to Used as Benefit Measure**
(a)	(b)	(c)	(d)
	0		

EWMP 11. Pricing and Incentives

Part 5. Economic Analysis (Worksheets)

Worksheet 3b. EWMP Water Supplier Avoided Costs--Future Sources

Complete the following worksheet for future sources eliminated or delayed because of implementation of the EWMP.

Alternative	Total Capital Costs	Capital Recovery Factor [1]	Annual Capital Costs	Annual O&M Costs	Total Annual Costs	Annual Yield	Cost/af
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
			(b x c)		(d + e)		(f / g)
		0.0782					

[1] For a period of 25 years and 6% discount rate.

EWMP 11. Pricing and Incentives

Part 5. Economic Analysis (Worksheets)

Worksheet 3c. Water Supplier Revenue Effects

Complete the following worksheet:

Parties Purchasing Conserved Water	**Amount of Water (af)**	**Selling Price ($/af)**	**Expected Frequency of Sales (%)** [1]	**Expected Selling Price ($/af)**	**Option Fee ($/af)**	**Total Selling Price ($/af)**
(a)	(b)	(c)	(d)	(e)	(f)	(g)
				(c x d)		(e + f)
	0		100%		0	

[1] During a 25-year analysis period, how many years are water sales expected to occur? For example, water sales to farmers might be expected to occur 90% of the years, whereas the frequency to other agencies might be 50% of the years,

[2] Option fees are paid by a contracting agency to a selling agency to maintain the right of the contracting agency to buy water whenever needed.. Although the water may not be purchased every year, the fee is usually paid every year.

EWMP 11. Pricing and Incentives

Part 5. Economic Analysis (Worksheets)

Worksheet 4. EWMP Water Supplier Benefits/Costs Ratio

Benefits and Costs	
EWMP Benefits ($/af)	
EWMP Costs ($/af)	**#DIV/0!**
Benefit/Cost Ratio	**#DIV/0!**

EWMP 11. Pricing and Incentives

Part 6. EWMP Financial Analysis

A water supplier may claim an exemption if:

"Adequate funds (including funds from other beneficiaries of the plan) are not available, and cannot reasonably be expected to be made available, for implementation of the EWMP during the term of the plan." (MOU, Section 4.02)

If the water supplier is claiming an exemption based upon the lack of available funding, please discuss the reasons for this finding. Please include a copy of your latest financial statement and a list of other potential plan beneficiaries who have been contacted.

SSWD is not claiming an exemption from the financial analysis, however a
financial analysis is not necessary since no alternatives are suitable for the
District's operation. Therefore, because SSWD currently provides the pricing
methods described previously, adequate funds are expected to be available to
continue services for water users.

EWMP 11. Pricing and Incentives

Part 7. Summary of Analysis

Potential Environmental Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Source of supply			X	
B	Confined/Unconfined Groundwater Levels			X	
C	Shallow Groundwater Elevations			X	
D	Instream Flows			X	
E	Drain Flows			X	
F	Fertilizer / Herbicide / Pesticide Use				
G	Soil Erosion				X
H	Field Burning and Fugitive Dust				
I	Energy Use			X	
J1	Vernal Pools and Swales				
J2	Riparian Habitat				
J3	Open Water Bodies				
J4	Marshes (permanent or seasonal)				

EWMP 11. Pricing and Incentives

Part 7. Summary of Analysis

Potential Third-Party Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
A	Confined/Unconfined Groundwater Levels			X	
B	Instream Flows			X	
C	Drain Flows			X	
D	Fertilizer / Herbicide / Pesticide Use				
E	Wind/Water Soil Erosion				X

Indirect Economic Effects Summary Table (from Part 4)

Section	Evaluated Component	Beneficial	Negative	Insignificant	Indeterminate
B	Farm Inputs				X
C	Local farm Labor				X
D	Processing of Farm Products				X

EWMP 11. Pricing and Incentives

Part 7. Summary of Analysis

EWMP Economic Analysis (from Part 5)

Water Supplier B/C Ratio	**#DIV/0!**

EWMP Financial Analysis (from Part 6)

	Yes	**No**
Can adequate funding be expected to be made available?	○	○

EWMP 11. Pricing and Incentives

Part 7. Summary of Analysis

Decision about EWMP

	Yes	No
Is this EWMP accepted?	◉	○

Discussion:

Please provide here and in the WMP a discussion of why the EWMP is accepted or rejected for implementation. Please include a discussion of estimated water savings, environmental effects, third-party effects, etc. for this EWMP.

SSWD establishes prices based on available surface water supplies in a manner to cover
its costs and provide an appropriate operational reserve fund. Considering that the District
provides only partial water supplies to its users and desires to maximize surface water
deliveries to maintain groundwater conditions, price incentives are not appropriate.
In essence, SSWD prices its water at the minimum price to promote maximum
surface water use.